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JULY

Building a No-Battery Set—Page 55

25 CENTS

POPULAR MECHANICS MAGAZINE

WRITTEN SO YOU CAN UN

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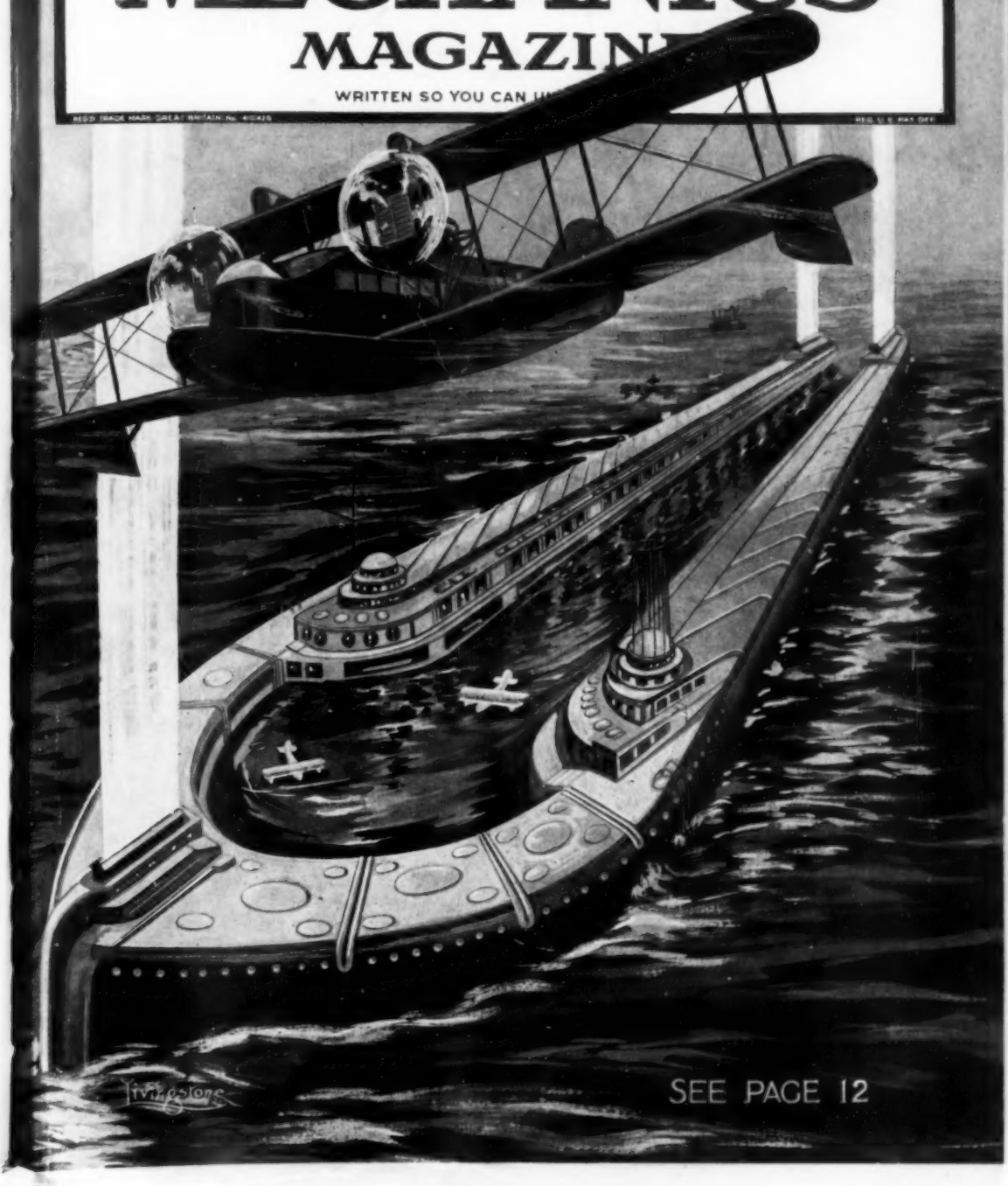

SEE PAGE 12

McSweeny will pull you out of the Ruck and help you make BIG MONEY

J. H. McSweeny "MAC"

You can earn $100 a week

You'd like to earn $100 or more a week—or be your own boss—wouldn't you? You can. You can be independent. All that I ask you to do now is simply to spend 2 cents—one postage stamp—and let me prove to you that this is *your opportunity.*

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This is a special message to red-blooded, two-fisted fellows who know they've got the stuff in them. You know what I mean. You're not satisfied. You see others around you making big money. You've got your eye open for the big chance. *This is it.* Listen to what George Smith of West Alexandria, Ohio, did. He was getting only $75 a month.

"Dear Mac:

"I am certainly grateful to you for the success I've had. If it hadn't been for you and your training, I'd still be plugging along on the farm. Now I can laugh at those fellows who told me I was foolish to quit the farm. *I am clearing $800.00 a month.* I'll tell the world McSweeny training put me over."

I can show you hundreds of just as enthusiastic letters from men who had been clerks, mechanics, farm boys, shop workers, of all ages—16 to 65.

Thousands of McSweeny-Trained Men Wanted

Automobiles are increasing at the rate of three million a year. The need for auto experts never was so great. Not just mechanics, but experts, skilled in auto electricity, starting and lighting, ignition, batteries, and all kinds of automobile repairing and trouble shooting—experts, with ability to direct men and operate a garage business profitably.

Complete Training in Only Eight Weeks

The automobile industry everywhere is eagerly seeking McSweeny trained men. McSweeny men have shown that they know their stuff. Many own their own garages now. You can get this complete training—*the start to success*—in only 8 weeks. It isn't book training—it's actual job work in McSweeny's big graduate shops. The instructors are all specialists—the pick of the industry. Equipment is modern and complete—autos, trucks, tractors, and stationary engines.

Shop Work—Not Book Work

McSweeny originated the graduate shop plan. The three big McSweeny schools in Cincinnati, Cleveland and Chicago are known from coast to coast. Start your success today. Let me show you how easy it really is. If you are interested in making big money, you'll send in the coupon now. Mail it to the nearest McSweeny Shop. This is the most liberal offer I have ever made. Tell your friends about it. Send the coupon now.

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I'll give you

FREE *Railroad Fare*

FREE *Board*

FREE

Kit of Tools

A BIG SURPRISE ?

The Special Summer Offer

WRITE TODAY

and I'll tell you all about it

act now

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MAIL THIS COUPON TODAY

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Popular Mechanics Magazine

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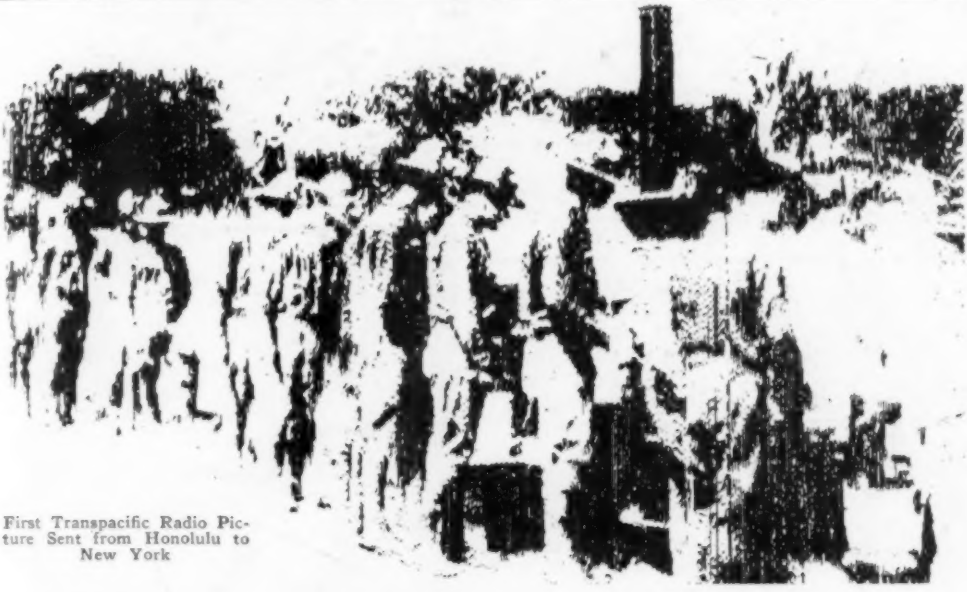
Vol. 44 JULY, 1925 No. 1



First Transpacific Radio Picture Sent from Honolulu to New York

Radio Photos Sent Five Thousand Miles

SUCCESSFUL transmission of photographs, by radio, from Honolulu to New York, a distance of five thousand miles, was accomplished during the army-navy war game maneuvers. While pictures had been transmitted between New York and London, the distance covered was not much more than half that bridged in the long aerial jump from the middle of the Pacific ocean clear across the United States. Likewise four relays were used in the Hawaiian stunt, the radio photographs passing automatically from one station to the next without human assistance. The transmitting equipment was stationed in Honolulu, twenty-nine miles from the broadcasting towers at Kahuka, while the receiving equipment in New York was seventy-six miles from the wireless station out at Riverhead, Long Island. From Honolulu the picture, translated by a beam of light into a series of electrical impulses, passed over land wires to the Kahuka wireless station, where a relay put the electrical current on the air, to be picked up at Marshall, Calif., 2,372 miles away. From Marshall receiving station, the wireless impulses, transmitted through a relay to a land wire, were telegraphed down to the high-powered broadcasting station at Bolinas, where another relay started the picture on its way again for the 2,640-mile jump to Riverhead. A final relay at the Long Island receiving station put the impulses back on another land wire for transmission to the radio offices in New York City.

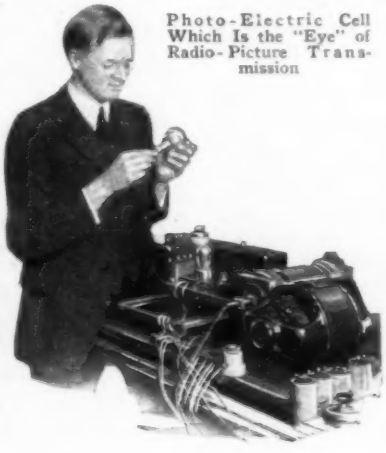
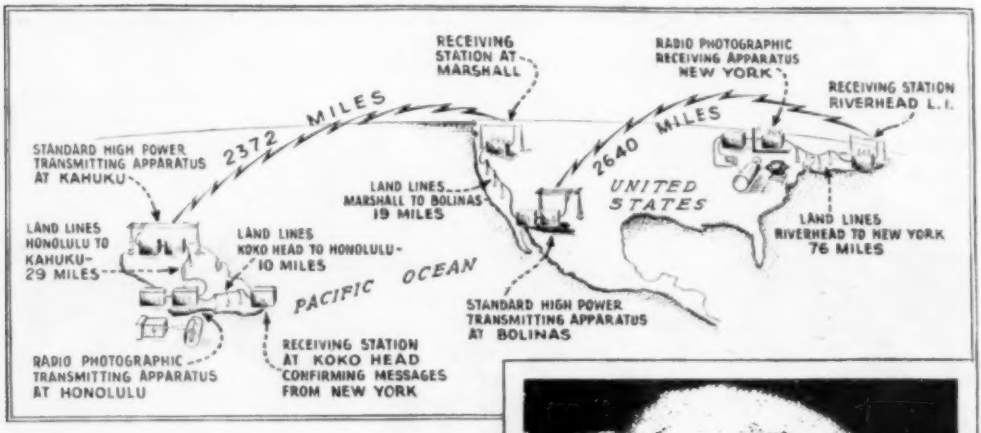


Photo-Electric Cell Which Is the "Eye" of Radio-Picture Transmission

The actual elapsed time from the instant


RECEIVING STATION AT MARSHALL
RADIO PHOTOGRAPHIC RECEIVING APPARATUS NEW YORK
RECEIVING STATION RIVERHEAD L. I.
2372 MILES
2640 MILES
STANDARD HIGH POWER TRANSMITTING APPARATUS AT KAHUKU
LAND LINES MARSHALL TO BOLINAS 19 MILES
UNITED STATES
LAND LINES HONOLULU TO KAHUKU 29 MILES
LAND LINES KOKO HEAD TO HONOLULU 10 MILES
PACIFIC OCEAN
LAND LINES RIVERHEAD TO NEW YORK 76 MILES
STANDARD HIGH POWER TRANSMITTING APPARATUS AT BOLINAS
RADIO PHOTOGRAPHIC TRANSMITTING APPARATUS AT HONOLULU
RECEIVING STATION AT KOKO HEAD CONFIRMING MESSAGES FROM NEW YORK

Picture Sent by Radio, and Map of Its Route through the Ether Waves

the transmitting machine started in Honolulu until the first impulse reached the recording pen in New York was less than one-fourth of a second, and in twenty minutes the first picture was complete. Seven photographs were sent in one morning without difficulty.

The system used employs a cylinder on which the film of the picture to be transmitted is wrapped. As the film revolves on the cylinder a tiny beam of light passes through it to a delicate photo-electric, or light sensitive cell, the amount of light reaching the cell depending upon the darkness or lightness of each section of the film. The light striking the delicate cell is converted into an electrical impulse, which is then relayed to the wireless transmitter for broadcasting.

At the receiving end a reversal of the process may be used to throw a tiny light beam on a photographic film to reproduce the original negative, or the electrical impulses may be sent through a pen arrangement which produces dots and lines to form a positive of the picture negative at the other end. The latter process was used to produce the illustrations appearing with this article.

The heart of the various forms of picture-transmitting apparatus, whether by radio or telephone wire, is the light sensitive cell. In this any variation in the light striking it is recorded by a corresponding difference in the amount of electrical energy which passes from the cell, just as sound in the telephone transmitter causes the diaphragm to vibrate, resulting in fluctuations in the amount of current passing through the wire.

At the receiving end the impulses are translated back into light in the same way that the telephoned impulses vibrate the telephone-receiver diaphragm and translate electricity back into sound. The greatest difference in the two processes is the use of the light sensitive cell.

AIRSHIPS TO HAVE TWO DECKS

Two separate decks and accommodations for 100 passengers are features promised in a giant airship of stainless-steel framework that is planned for traffic between England and India. Its motors are to use a heavy gas oil, eliminating the fire hazard to such an extent that passengers will be permitted to smoke during the voyage. A smoking room is included in the plans. The ship will be 720 feet long, 140 feet in diameter and will contain two-bed sleeping cabins.

HORSEPOWER FOR EACH PERSON EQUALS FORTY-EIGHT SLAVES

Every man, woman and child in the United States has six horsepower, or the equivalent of forty-eight slaves, to draw water, furnish light, carry messages and perform many other services for his comfort and necessity, according to C. F. Kettering, president of the General Motors Research corporation. This estimate is based on the assumption that the average work capacity of a human being is one-eighth horsepower and the total mechanical horsepower developed in this country is 700,000,000. Egypt, Rome and Greece enjoyed their highest progress when they had the largest number of slaves, Mr. Kettering points out, and, although human slavery has been abolished here, development continues because there is constantly more efficient conversion of materials in the earth's crust into useful articles. By our standards a Chinese coolie, who works for ten cents a day, is paid twenty times what he is worth, because he can only move one ton one mile in a day, while the railroads in America move one ton one mile for half a cent, illustrating the difference between man and mechanical power.

HEADLIGHT DIMMER ON WHEEL INCREASES AUTO SAFETY

Steering wheel and auto-headlight dimmer have been combined to simplify the driver's task and to increase the safety of operating the car at night. Without removing his hands from the control, the chauffeur can dim the lights simply by pressing a small switch that is fitted into a grip within convenient reach. The wheel is of the oversize type and can be attached, very easily, in a few minutes.

"EAR" DETECTS HUM OF PLANE TEN MILES AWAY

Sensitive airplane detectors that can catch the hum of a motor ten miles away have been tested at Fort Totten, N. Y., with other anti-aircraft equipment. The instrument consists of four long horns, like those of loud speakers, connected to helmets that slip over the ears of the observers, and has a locating mechanism to turn it in the direction of an approaching plane. Having once picked up the ship, the task of getting the range with spyglasses and guns is simplified, as the detectors warn of the plane's approach long before it is visible.

Locating Distant Plane by the Hum of Its Motors in Sensitive Detectors That Register the Sounds Ten Miles Away

WATER IS SWEETENED WITH AIR TO PREVENT DISEASE

New York city's water supply is carried through pipes for such a great distance that it is necessary to sweeten it with air and sunshine to guard against contamination. This is done in huge aeration plants where the water is ejected through perforated pipes. High, open country amid flowering fields is chosen as the place for the process, and the area is fenced in to prevent foreign matter falling into the water. A mist hangs over the falling jets usually, and on sunny days, rainbows are plainly visible in the spray.

Big Bills from Mother Nature

Brazilian Toucan's Bill Is Large but Thin and Helps in Eating Fruit and Fighting Monkeys

Keen Eyes and a Short, Hooked Beak for Tearing Flesh, Cause the Vulture to Be Feared as a Bird of Prey; Right, White Pelicans at Rest; Their Cumbersome Facial Equipment Is Ideal for Exploring Pools and Marshes and Catching Fish

What the Heron, at Left, Lacks in Length of Bill, Is Gained in Long-Neck Reach; Right, One of the Fifty Species of Hornbills, Fierce Birds with Helmets

When the Scarlet Ibis Feeds, It Scarcely Has to Stoop Over Because of Its Long, Slender Beak, as Shown at Left; the Other Bird Is a King Vulture, Distinguished by Its Brilliantly Colored Bald Head and the Fleshy Appendages over Its Powerful, Blunt Bill

SCRAMBLING THE RADIO WAVES TO BEAT STATIC

Scrambling the waves from all the European radio stations into one mess in order to get away from atmospheric interference seems like an unusual way of making radio clearer, but is actually used by the great transatlantic receiving stations at Riverhead, L. I., and Belfast, Me. The big wireless station on Long Island was designed to eliminate static interference, and does, but a thunderstorm in its immediate vicinity causes all kinds of trouble. Constant and uninterrupted communication with Europe was necessary, because all the foreign signals are picked up by the one big antenna and sorted out in a battery of receiving sets, each one tuned to a different station. To get around the thundershower trouble, a second receiving station with ten miles of aerial was erected at Belfast, Me., on the theory that when there was a storm on Long Island there probably would not be one in Maine, and vice versa. The Maine station picks up the same European signals, but instead of transmitting them to receivers, the entire lot is shot into one short-wave transmitter, which sends out the scrambled mess to be picked up by a special short-wave receiver at the Long Island plant, unscrambled into their proper long-wave signals and passed to the battery of receivers.

FOLDING PIPE FITS VEST POCKET AND HAS SAFETY COVER

For the convenience of smokers who prefer a pipe, one which folds up into compact form, and shaped to fit the vest pocket is being manufactured. It serves as a handy article for either indoor or outdoor smoking, since it cannot spill, and the contents are prevented from being blown about by the wind. A perforated top for closing the bowl after filling protects the clothing from injury should the pipe be placed in a pocket while burning. Its small size when collapsed also eliminates wear and tear on pocket linings often caused by ordinary pipes.

Pipe Folded into Case and Extended

VANITY BOX IN PARASOL GRIP SAVES CARRYING CASE

Trouble of carrying the vanity case as a separate article is avoided with a parasol of French design. In its handle, it has a small compartment for powder, puff and other accessories, and a round mirror at the end of the grip. The glass is protected, when not in use, by a sliding lid.

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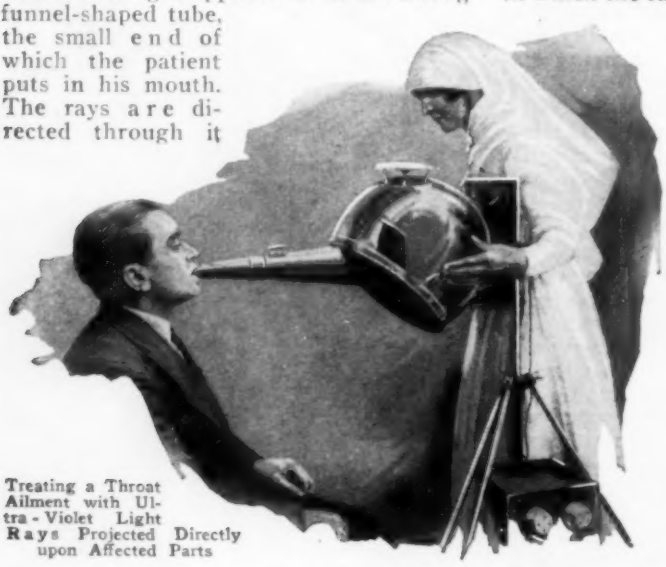
Demonstrating Parasol-Handle Vanity Case: the Mirror with Protecting Cover Is at End

EYEGLASSES RESIST GUN FIRE WITHOUT SPLINTERING

Splinter-proof glass for spectacles was tested with hammers and shotgun bullets during a London demonstration to prove its strength. Lenses of the material were fired at from a distance of thirty yards but no shot penetrated them and no chips were broken off. It is said that the glass can be ground to any curvature required for the eyes. It is intended chiefly to meet the needs of football players and other sportsmen who run the risk of serious injury in wearing ordinary glasses while participating in games. This is the first time such glass has been made into lenses.

DRINK OF ULTRA-VIOLET LIGHT AIDS THROAT TREATMENT

Treatment of certain throat diseases is given at a London hospital with a special ultra-violet light apparatus. It has a long funnel-shaped tube, the small end of which the patient puts in his mouth. The rays are directed through it so that they fall upon the affected parts and little of their beneficial powers is lost.



Treating a Throat Ailment with Ultra-Violet Light Rays Projected Directly upon Affected Parts

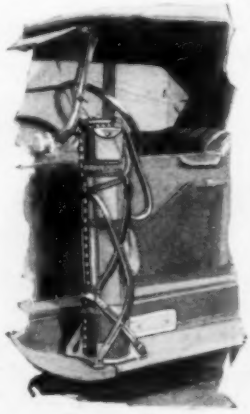
OLDEST CHILD IN THE FAMILY MOST LIKELY TO SUCCEED

Studies made by Prof. William Ogburn, of Columbia university, indicate that the oldest child in the family most frequently succeeds in life, the youngest ranks next and intermediate children third. Three thousand names were selected at random for a survey: 1,000 artists, including doctors, musicians, authors and painters; 1,000 scientists of all grades, and 1,000 of a more general classification, including business men, journalists and men of "good mixing qualities." Questionnaires were sent to these individuals with the request that they indicate their position in the family. Replies were received from 1,700. Turning to "Who's Who" as a criterion of success, it was found that of the 577 who were the oldest sons in the family and had brothers less than five years younger, 342 appeared in the lists of noted men; 155 out of the 398 who were the youngest children with brothers five years older were in the book, but of the 729 who were intermediate children, only 237 could be found in it. These data were regarded important in measuring early influences.

BOILER BURNING OIL IN WATER ELIMINATES FLUE LOSSES

Another effort to produce a successful internal-combustion boiler, that is, one in which the fuel is burned directly in contact with the water, has been made by a Belgian engineer who asserts that his apparatus has worked continuously for months. Fuel oil and the air necessary for combustion are supplied to a burner under pressure slightly above that of the steam, and care is taken that the water level is not above the lower mouth of the burner. Ignition is first accomplished in a special lamp until a flame burns in the generator. A connecting valve to the reservoir is opened, and water allowed to rise to the middle of the burner. The flame continues to burn, converting the liquid into steam which can be superheated to any degree in a special unit. Although losses due to the presence of flues in the ordinary boiler are eliminated by this system, one of its drawbacks is the necessity of compressing all combustion air to more than full boiler pressure.

FOLDING HOLDER FOR GOLF BAG FITS AUTO RUNNING BOARD



Golf clubs are carried to the links in the auto with little trouble in a collapsible holder for the bag that fits on the running board and folds flat when not in use. It opens and closes like a jumping jack, may be installed as a permanent fixture, has four steel bands which hold the bag snugly without the need of straps and is finished in durable and attractive nickel.

Three Nations in Air Race to Polar Lands

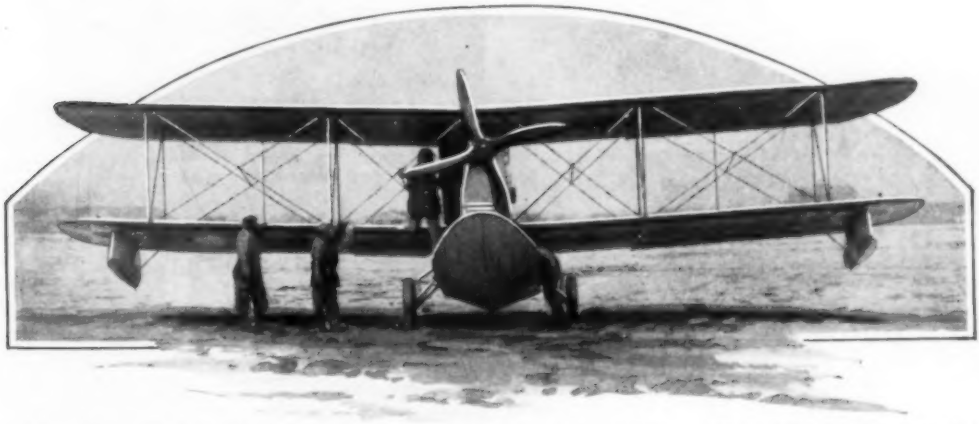
SEEKING to raise the American flag over a vast unknown continent, believed to be located northeast of Alaska, intrepid American scientists, accompanied by naval flyers with two amphibian planes, will invade the far north this summer on one of the best-organized polar expeditions in history.

Their ultimate destination is a million square miles of unexplored territory lying between northernmost Alaska and the pole, and in this region they hope to find the mysterious Arctic continent whose high shores the late Admiral Peary reported sighting, though open water kept him from adventuring farther.

With the two navy planes, capable of landing on either land, ice, or water, and with the pick of the navy flyers for pilots, the expedition, led by Donald MacMillan, hopes to make a photographic map of a large section of the far north, including not only the mystery area of a million square miles, but likewise the interior of Ellesmere and Baffin lands, and that part of the north Greenland ice cap never seen by white men. If they succeed the earth's unknown areas will have dwindled to two —a part of the frozen antarctic and a portion of the jungle fastness of interior South America.

While the Americans are preparing to leave Wiscasset, Me., two other expeditions will be racing for the pole from the opposite side, both using planes in the first polar air derby. One expedition, led by Capt. Roald Amundsen, established a base in northern Spitzbergen, 650 miles from the pole, early in April, landing there with two big twin-motored flying boats. The second expedition from the other side of the globe is to be led by Grettier Algarson, flying the English flag. He explored the territory north and east of Spitzbergen last summer, and is returning this year with a small blimp to attempt to reach the north pole from a base in the Franz Josef islands, north of Nova Zembla, and only 550 miles from the pole and 100 miles from Spitzbergen.

Donald B. MacMillan, Arctic Explorer, Who Leads Expedition to Seek Million Miles of New Land for U. S.



One of the Loening Amphibian Planes, Capable of Landing on Either Land or Water, Which Will Be Used by the Navy Flyers Accompanying the MacMillan Arctic Expedition

The MacMillan expedition, under the American flag, unlike the other two, is not interested in the north pole, and will make no effort to reach it. "Admiral Peary has been there, and there is no object in our going back at this time," according to Lieut. Commander Byrd, who will command the navy flyers. Instead of entering the international air race to the top of the earth, the MacMillan expedition will devote itself to hunting the arctic continent as an addition to the lands under the Stars and Stripes, and to carrying out other scientific work.

Bound north along the coast of Labrador, MacMillan plans to stop and explore ancient Norse ruins which lie almost west of Greenland, and which are supposed to mark a settlement established on the American mainland about the year 1020 by Leif Erickson, the son of Eric the Red, and which, if true, antedates Columbus' discovery by more than four and a half centuries. From the Labrador ruins the party will sail across the straits to Greenland and stop to compare ancient ruins left by Eric the Red there, in an effort to prove the common origin and time of both. From there they will follow the retreating ice northward to Etah, an Eskimo settlement above Smith sound, and if possible will push on north into Kane basin. Regardless of which location is chosen for a base, the real work of the summer will start from there. To the east lies the northern Greenland ice cap, an age-old plateau of ice which no white man, and probably no native, has ever seen. The airplanes will be sent out to map the region with a camera and determine what lies behind the ice ramparts.

With the ice cap mapped, an aerial expedition will wing north to Cape Columbia, the jumping-off place at the northern tip of Grant land, from which Peary launched his successful trip to the pole. Here he left valuable records, and the flyers will open his rock cairn and copy the documents in order that they may help fill out the story of the pole discovery. At the same time it is possible that the flyers may find a trace at Cape Columbia of either Amundsen or Algarson, since both will make that point their objective in the event that anything prevents their returning to their ships. Both will carry food, sleds, skis, guns and ammunition, and if they are forced down near the pole, will head for the cape, which is only 450 miles from the pole, as

Eskimo Hunters, with Bow and Spears, Down a Huge Polar Bear, One of the Explorers' Food Sources

compared to 550 miles to Algarson's base and 650 to that of Amundsen.

After the Cape Columbia trip, the naval flyers will set to work to ferry MacMillan's supplies and the geologists and other experts to a base camp 250 miles northwest of Etah, on the northern shore of Axel Heiberg land. Flying back and forth, they will transport the camp equipment and scientific instruments to the base camp, and with that established, start out on the great adventure of the trip—the search for the supposed arctic continent. Belief in its existence is founded not only on Admiral Peary's report of sighting land in the distance, but on observations extending over more than forty years. Gen. A. W. Greely, dean of living explorers and commander of the ill-fated expedition of 1881-84, advanced the belief at that time that there was land in the unknown area, basing his claim on the peculiar structure of arctic icebergs, which could only have come from a flat land, quite unlike Greenland and the surrounding area.

While naval flyers, photographers, map makers, geologists, botanists and ornithologists are carrying on their scientific studies, an equally important investigation will be under way from Etah, where a study is to be made of the northern lights and the magnetic pole, and their effect on radio. MacMillan carried the first radio set into the far north on his earlier trip and kept the world informed of his progress through it, while the

One of Amundsen's Planes, Above, and the Ship Which Will Carry Algarson's English Expedition to the Far North in Polar Dash

radio brought news and entertainment, as well as a talk by his own sister to him.

Eugene F. MacDonald, of Chicago, president of the National Association of Broadcasters, is going to accompany the expedition together with operators and radio engineers and several transmitting and receiving sets, including a short-wave outfit. Radio experts believe that the short waves will overcome the difficulties of competing with the aurora and other electrical manifestations in the far north, and will reach America every day, despite the twenty-four hour daylight of the north. The messages received over the twenty-meter outfit will be stepped up and rebroadcast by several American stations, using their own wave lengths, so that the entire country may be able to listen in and hear Eskimo tribes singing their folk songs, as well as get daily reports on the expedition's progress. The planes are to be equipped with short-wave sets, and will be in constant communication with the base camp, so that if one comes to grief a relief party may speed to the rescue.

The Loening amphibian planes are capable of carrying three men and 350 pounds of equipment each, or two men, on the ferry trips, and a correspondingly larger amount of supplies. Pilots, mechanicians, riggers, navigators and photographers are included in the navy personnel of enlisted men and officers, all of whom volunteered for the hazardous duty. In addition to three men, each ship on exploration flights will have 100 pounds of radio equipment, 150 pounds of food, camping equipment, firearms, ammunition and harpoons, and 100 pounds of photographic apparatus.

Including the three naval officers and three enlisted men, the expedition is to number sixteen, in addition to a ship's crew of twenty-five, making it one of the largest, as well as the best-equipped party ever to invade the north.

Like the MacMillan expedition, the Amundsen party is elaborately equipped, and is supported by a meteorological station established in north Spitzbergen, to chart the weather, while a wireless plant at the same point will pick up special weather bulletins from Nome and Canadian points to help in selecting a favorable time for the flight.

The English expedition is the smallest of the three, and will take the greatest risks. In the hold of their ship they will carry a small blimp, built during the war for British coast-patrol duty, and with it 50,000 cubic feet of hydrogen gas, stored in tanks. Arrived at Franz Josef land, Algarson plans to fill the blimp, and, accompanied by two British naval officers, sail for the north pole. He hopes to reach the pole and return to the ship, but if winds or other causes prevent, will try to reach Cape Columbia.

Assembling the American Amphibian Plane, Showing How the Landing Wheels Are Arranged to Draw Up into the Boat Hull When the Ship Lands on the Water: the Sturdy Metal Fuselage Is Well Riveted Together

YEARLY FALL OF STAR DUST TWELVE THOUSAND TONS

Although the annual fall of star dust is estimated at 12,000 tons, this quantity is small in view of the large number of meteors that hourly plunge into the earth's atmosphere. Most of them are consumed by friction developing from their terrific velocity. Between thirty and sixty meteors are visible each hour in the whole night sky from a fixed position but as only those within a few hundred miles can be observed, the total probably is several millions daily. It is estimated that it would take a thousand million years to cover the earth with a layer of star dust one inch thick at the rate it now is falling. Dust that collects on shelves and cornices contains a small percentage of tiny particles from "shooting stars." Among the largest meteors recorded is the one which fell in Greenland and was taken to New York by Commander Peary. It weighed more than thirty-six tons.

RAINFALL AND FRUIT

In cool, rainy seasons, apples and some other fruits are likely to ripen more slowly and evenly and therefore keep longer after picking, English growers maintain. Hot weather sometimes forces the development, producing less solid fruit. Tests with a box of three carefully selected varieties of apples not long ago, proved that they were able to withstand the ocean voyage from England to South Africa and back again, only one in the shipment being spoiled. Apples raised in Australia and New Zealand are being imported into England. If the fruit is in good condition when picked, with care it will keep for the greater part of the winter.

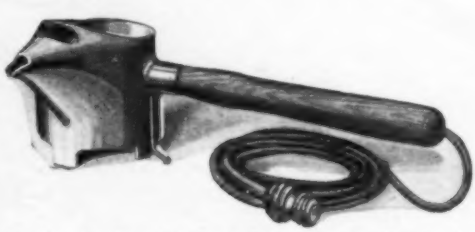
MOSQUITO UMBRELLA IS USED TO REPLACE SMUDGE POT

Protection against insect pests of the summer is provided by an umbrella topped with mosquito netting. The lower edge of the netting is hemmed and has an elastic band which holds the fabric tightly around the body under the user's arms. The screen is designed to replace smudge pots in mosquito-infested districts, and has the advantages of portability and simple adjustment.

Shroud of Netting over Umbrella with Elastic Band at Bottom to Keep Covering Tightly Closed against Insects

LADLE HEATED BY ELECTRICITY KEEPS CONTENTS LIQUID

Heated by electricity supplied from any convenient wall socket through a cord, a pouring ladle has been devised for plumbers and other mechanics to keep solder and like materials in a liquid state. The heating unit is contained between the walls of the pot, the long stout handles afford a secure grip, and the spout of the ladle is so shaped that difficult places may be easily reached.



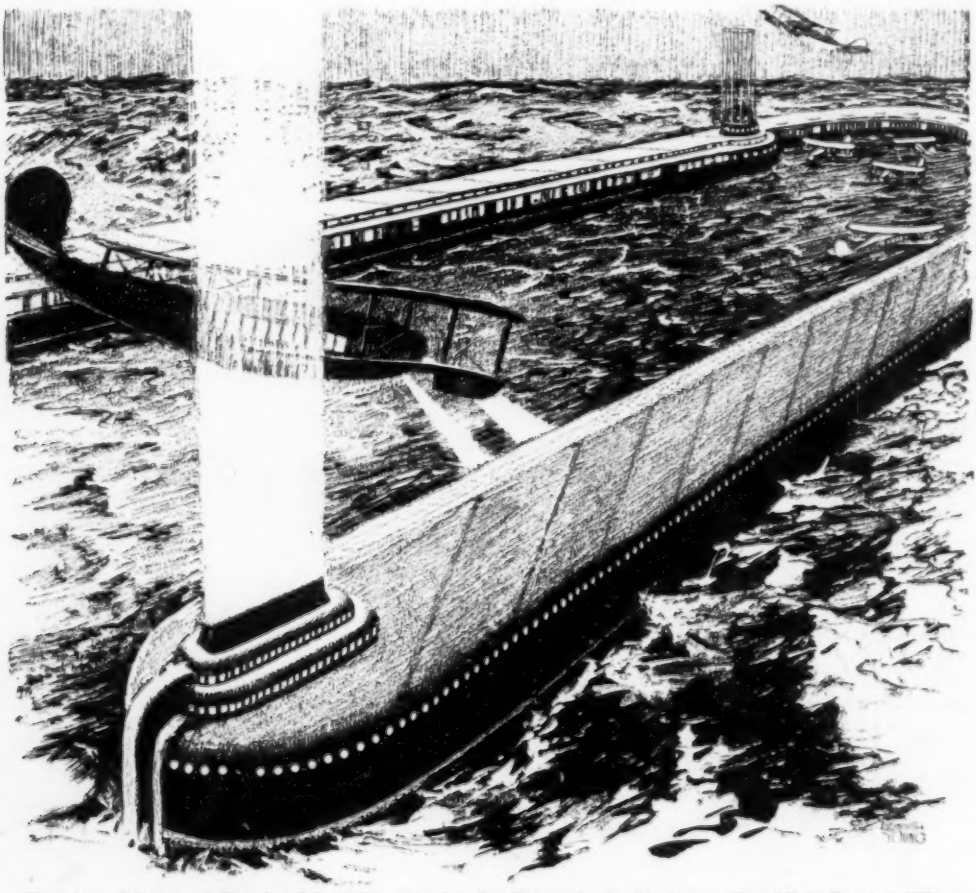
Pouring Ladle with Cord Connection in Handle for Insertion into Wall Socket

FLOATING ISLES TO FACILITATE TRANSATLANTIC AVIATION

Plans for the construction of floating islands in the Atlantic to facilitate aviation, have been presented to the Institute of France and have been awarded two prizes. American, British and German projects had been offered but did not solve practical difficulties. The French scheme calls for a reinforced concrete structure, heavily ballasted and shaped like the keel of a boat with an open bay between its wings upon which aircraft will alight. Motors would keep it hovering about the same point with its nose to the wind, to protect the sides from the waves. Workshops and supply rooms would occupy one wing and hotel rooms for passengers and a wireless station, the other. In the prow, hangars would be constructed to open on the basin. At night, powerful searchlights would direct their rays upward to guide the flyers. The unique port, as planned, will be 450 yards long, 250 yards wide and can be built at an estimated cost of about $13,000,000. It is proposed that four of the islands, equidistant from each other, be laid down between New York and Brest.

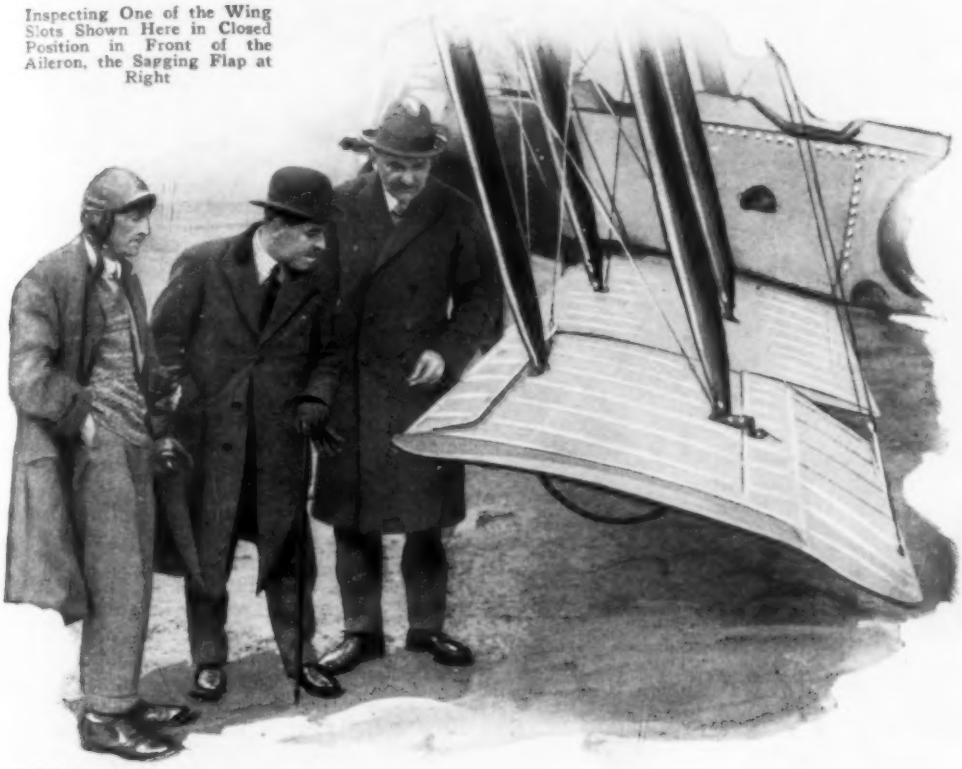
"SNOW" FROM COTTONWOODS PREVENTED BY ACID SPRAY

Spraying seed-bearing cottonwood trees with a two-per-cent sulphuric-acid solution has been found an effective way of preventing the showers of fluffy down that often prove a nuisance later in the year. The preparation can be applied with the usual equipment and at slight cost. Trees that require the treatment are distinguished from the others by their buds, which have small greenish clusters instead of the "red neckties" that grow on the male or cottonless trees.



Drawing of Proposed Floating-Island Way Station for Transatlantic Airplanes; Searchlight-Bearing Wings Inclose Landing Bay and Contain Workshops, Repair Rooms and Wireless, besides Hotel Quarters

FLYING RISKS CUT BY SLOTS IN WINGS OF PLANE



Inspecting One of the Wing Slots Shown Here in Closed Position in Front of the Aileron, the Sagging Flap at Right

Courtesy London Times

Ideas on what is possible in flying were revolutionized at Croydon, England, when a pilot caused his airplane to lose its flying speed at a low altitude. Aeronautical experts, gazing up into the sky, held their breath, expecting the machine to spin into an uncontrollable dive, and crash to earth. But the plane merely hung motionless in the sky for an instant. Next, the airman swung his craft round, with its nose up and its tail down, flew off, and, shortly after, made a perfectly safe landing. This mechanical wonder was achieved by the operation of the Handley-Page slotted-wing device, consisting of an adjustable slot, right through the planes, 18 inches behind the leading edge. When open, this slot increases the lift of the machine in the air and allows a smaller area to support a greater weight at a lesser speed. The wing-slot system, worked in conjunction with the balancing planes or ailerons, gives the pilot, it is claimed, six times as much control over his airplane as anyone has ever had previously. If the airplane "stalls" (loses its flying speed, which lifts it in the air), the pilot need not lose control. He can prevent his plane from spinning and crashing to the ground, and can keep it on an even keel, so that, if his machine sinks to the ground, all the injury he will sustain will be a damaged undercarriage, and no personal hurt. The wing slots are controlled by the movement of a single hand lever, and ailerons—hinged flaps at the rear of the plane, controlling it laterally—are made more efficient by a slot between the main plane and the aileron. This acts similarly to the front-wing slots. An English insurance company has given a rebate of one-third in rates charged on airplanes fitted with the new wing-slot device.

PEARLS FROM FISH SCALES

Artificial pearls that market for as much as $200 each are being manufactured from herring scales on the Massachusetts coast. Only experts are able to detect them from natural gems, it is said, and many of them possess rare beauty.

Mind Tests Help Students to Pick Careers

Copyright, Kadel & Herbert

Tuning In Radio Program While Driving Car with Set Attached to Instrument Board and Loud Speaker above Windshield

RADIO SET FOR MOTORIST FITS AUTO INSTRUMENT BOARD

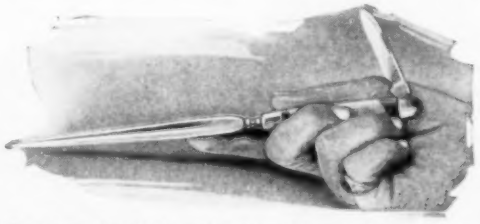
A novel installation of a radio-receiving set has been made on the instrument board of a closed-type automobile, where it may be easily operated by the driver while speeding along the road. The control panel is neatly attached directly in front of the steering gear, and the mechanism of the set is hidden behind the instrument board, where it cannot interfere with the movements of the driver. Overhead and at the top of the windshield is the loud speaker. The unit is a five-tube outfit, receiving its power from the battery of the car. The aerial consists of sixty feet of antenna wire, carefully strung along the ceiling of the machine and concealed by a covering of cloth that matches the interior finish of the vehicle. No difficulty is experienced in tuning in while the car is running, and on long-distance trips the tourists may keep in constant touch with world events through stations broadcasting the news of the day.

SOME PLANTS OF PREY

Beasts and birds of prey are common but there are also ravenous plants that trap and devour flies and other insects. One of the most familiar of these is the pitcher plant of the tropics, which has hinged lids that can be closed over cavities containing a thick fluid. Attracted by the perfume and color, insects are drawn inside the prison, the lid shuts down, and the victims are slowly digested by the plant. Sundew, bladderwort and teasel, and the common butterwort of swamps in England, also trap prey. The first-named exudes a sticky fluid which entangles flies like fly paper. Tiny hairs slowly close over the victim and in two days there is nothing left but a pair of wings.

JACKKNIFE IN LETTER OPENER CONCEALED IN HANDLE

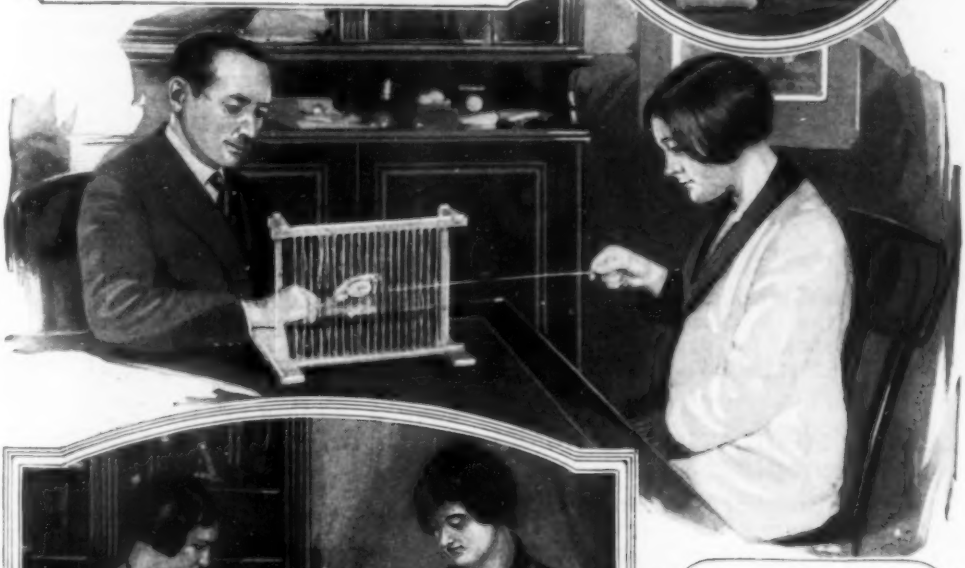
A combined letter opener and penknife which has an extra blade that folds into the handle forms a convenient tool for the writing desk or office mail table. The cutter is light and easy to manipulate and can be kept on a tray or pencil rack handy to the worker. The folding blade, which closes smoothly into the handle, may be used for sharpening pencils, erasing ink marks, and similar tasks where a keen edge is required. Ample space is provided on the grip for advertising matter or printed inscriptions.



Combined Jackknife and Letter Opener with Blade in Handle Raised to Show Position

Mind Tests Help Students to Pick Careers

Setting Pegs in Shortest Possible Time and Checking Them on Meter Is a Test Given Prospective Engineers; Right, Measuring Sustained Blowing Effort

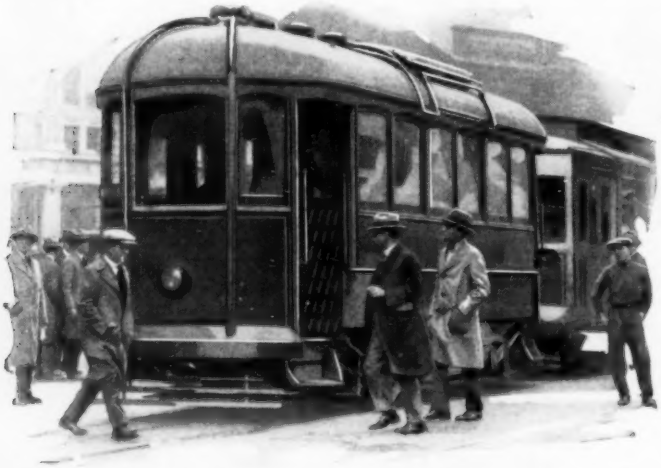


While Examiner Holds a Stop Watch, Candidate Pierces as Many Rings with a Long Needle as She Can in Allotted Time to Demonstrate Steadiness of Nerves and Strength of Wrist; Left, a Free-Arm Speed and Accuracy Test, Its Object Being to Take the Thimbles off the Forward Pegs and Place Them on the Rear Row Quickly and without Slips While the Instructor Keeps the Time Record

Copyright, Keystone View Co.

GASOLINE-DRIVEN STREET CAR TESTED IN NEW YORK

Gasoline as a substitute for electric power has been tested in a specially constructed street car on one of the lines in New York City, and the first experiments are said to have proved successful. Although the car is considerably shorter than the usual type, its engine is built so compactly that it does not greatly decrease the space for passengers, and its small size is expected to relieve traffic congestion.



Pipes Replace Trolley on Roof of Gasoline-Driven Street Car, and Front Controller Has Given Way to Concealed Motor

RATE OF POPULATION INCREASE DECLINING IN U. S.

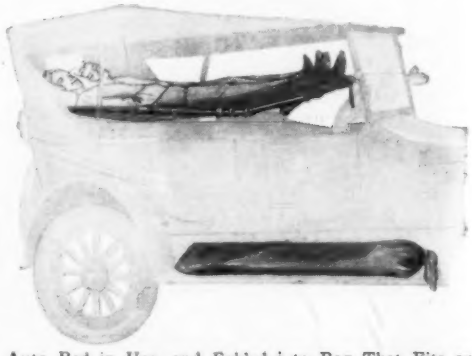
The population of continental United States on January 1 of this year was 114,311,000, according to estimates prepared by the national bureau of economic research. The survey reveals that the rate of increase is declining, the last year's gain, 1,627,000, being only 1.44 per cent as compared with 1,996,000 or 1.80 per cent increase for 1923. A growth of 1.42 per cent and 1.60 per cent was recorded for 1922 and 1921, respectively. Decreases in the birth and death rate and in the number of immigrants were noted, immigration accounting for only one-fifth of the population increase in 1924. It was also found that more persons are working for some one else than ever before. Only 9,657,000 were in business for themselves last year. Employes increased from 29,959,000 in 1920 to 33,566,000. It is estimated that the population of the country will be 148,700,000 by 1950.

ARTIFICIAL TIDE FROM SHIPS DISLODGES STRANDED BOAT

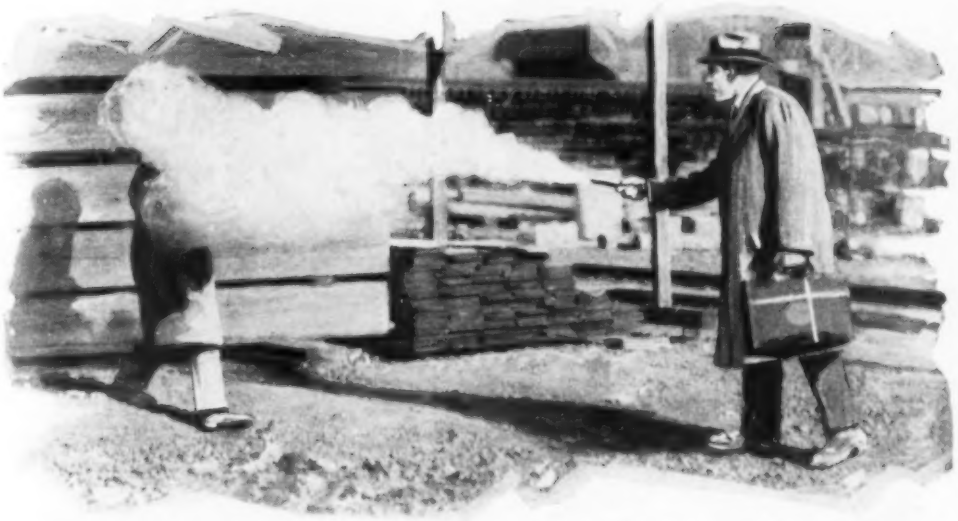
Artificial tide created by rapidly moving ships succeeded in dislodging a merchant steamer that had run aground near Chefoo, China, after the combined hauling efforts of two big tugs and four torpedo-boat destroyers, ordered to its assistance, had failed. The tugs, with towlines attached to the wreck, were secured in tandem and started away from the beach with the engines going at full speed. The four destroyers steamed some distance out to sea, then turned and dashed in at a speed of thirty knots. Sweeping as close to the stranded steamer as possible, they piled up an artificial tidal wave about four feet high, which was sufficient to lift the wreck clear of the beach so that it could be towed out to deeper water and safety.

SUSPENSION BED INSIDE AUTO FOLDS UP IN SMALL BAG

For the sedan or touring car, a folding suspension bed that can be set up or taken down in less than five minutes, fits into a cover not much larger than a golf bag when not in use, and weighs only thirty pounds. It rests on top of the seats, is partly braced to the steering wheel in front, and is adjustable to accommodate persons of different length or fit larger and smaller cars.



Auto Bed in Use, and Folded into Bag That Fits on Running Board



Demonstrating Operation of Tear-Gas Club on Actor Posing as Bandit; at Release of Button, a Blinding Cloud Streams Forth with Effective Range of Fifty Feet

CLUB FILLED WITH TEAR GAS TO ROUT BANDITS

Bank messengers and others likely to be attacked by bandits are afforded a protecting weapon in a short club filled with tear gas, which is released at the touch of a button. The vapor shoots out as a sudden cloud, and is said to temporarily blind anyone within fifty feet. The "billy" is small enough to be used at close range and can easily be concealed in the clothing.

PICTURE PUZZLES IN COIN BOOK TEACH CHILDREN THRIFT

A coin book which teaches children to be thrifty and provides amusement for the tots, consists of a puzzle-picture book with holes into which the money is inserted. As each coin is pressed into its place, a section of a picture is pasted over it. When the page of holes is entirely occupied with coins and covered with the patches, it presents a complete nursery picture. Suitable verses to encourage saving are printed on the pages opposite to those holding the money, making an attractive volume of illustrated rhymes as well as a valuable home bank. Space is also provided in which may be inserted advertising matter of banking institutions that may desire to distribute the books.

Coin Book Which Contains Picture Puzzles to Encourage Children to Save Their Money

PILLS THAT KILL CRAWFISH REDUCE CROP LOSSES

Crawfish are said to cause millions of dollars' worth of damage each year to crops on the rich prairie lands in the south, but a way has been found to stop their depredations by means of pills that produce a deadly gas when they strike water. The pellets are dropped into the holes that the pests burrow in the ground. The gas, which forms instantly, is said to kill every living thing it reaches. This remedy has been patented and given thorough tests in the past two years. It is heralded with great hopes, as the crawfish have proved immune to arsenic and other poisons tried before. The destructive creatures work at night, coming out of their holes and cutting the green growth for a radius of several feet. They are found in greatest abundance on the richest lands and sometimes burrow to a depth of twenty feet or more into the ground.

Homes for Lean Purses

By H. H. WINDSOR, Jr.

PLANS for small homes of good construction and excellent design are now available to readers of Popular Mechanics Magazine. If you contemplate building a small house, you may obtain these plans, which include a list of materials, a "fool-proof" specification, contract forms, blueprints, and in addition you may have expert counsel and advice during the building of your home, all at a cost so low that in many cases it is less than one-tenth what such service usually commands.

This service is offered to readers by Popular Mechanics Magazine in co-operation with the Architects' Small House Service bureau as a new and distinctive advance in the field of small homes. The bureau does not provide service for houses larger than six rooms, and advises everyone to employ a competent local architect for every job, big or little. It urges people to procure individual designs and constant expert supervision while building. If, however, the home builder is unable to obtain the service of an architect, that is the point where the bureau steps in and says, "Use bureau service next, if your house is a small one."

In addition to any service which the bureau movenient provides, it always recommends that a local architect be employed to supervise the building of a house. If that is impossible, the bureau stands ready to back the home builder with expert counsel, and, in fact, appears in the printed specifications and contract forms which it supplies, as the party of the third part—a home builder's architect.

The bureau has several hundred stock plans already prepared. It functions through eight regional bureaus, in various parts of the country, the members of which design homes suited to the climate and needs of their particular locality. Plans drawn for a house in California might not be suitable for the middle west, or an eastern home for the Rocky Mountain states, but each regional bureau is ready to furnish just the type of house needed by Popular Mechanics Magazine readers.

To obtain printed suggestions of many homes with floor plans and general information about each house, the reader is under no obligation except to write to Popular Mechanics Magazine stating his needs, and inclosing a stamped and addressed envelope for a reply. The request will be turned over to the bureau, which will send suggestions from which to make a selection. With a house selected, the

Italian-Type Bungalow, with Stucco Walls over Hollow Tile and Roof of Tiles in Variegated Reds, Browns and Grays, and Attractive Old-Fashioned Shutters

complete blueprints, specifications, quantity survey and blank contract forms may be obtained, on approval, for an inspection fee of $5.50. They may be retained for fifteen days, thus permitting the prospective home builder to submit them to as many local contractors as he desires and get competitive bids on the work. If he decides to go ahead and build, the inspection and estimating fee will apply on the price of the service, ranging as it does from $17.50 to $32.50.

If the bids received are too high, or another type of house is desired, the plans may be returned and others obtained, without payment of any additional inspection fee. So long as plans are returned in good condition the first $5.50 fee, except mailing charges, will permit Popular Mechanics Magazine readers to obtain additional sets of plans until they find one that suits them. For the future home builder who needs more assistance in planning a home and financing the building of it, the bureau offers several home-building books at cost. They contain from fifty to more than 100 plans each, on planning, financing and saving money in building, as well as advice on how to arrange for home-building loans, first and second mortgages, or contracts to deliver deeds.

FIRST FLOOR
CEILING HEIGHT 8'-6"

The architects' bureau is a little over five years old, but in its brief life has been respon-

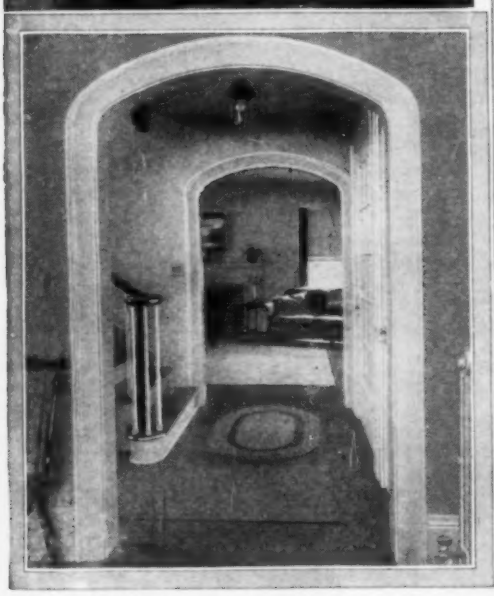
sible for the building of several thousand homes. The investment in houses built from its plans last year totaled millions of dollars, and every house built stands out from its neighbors because of its tasteful design.

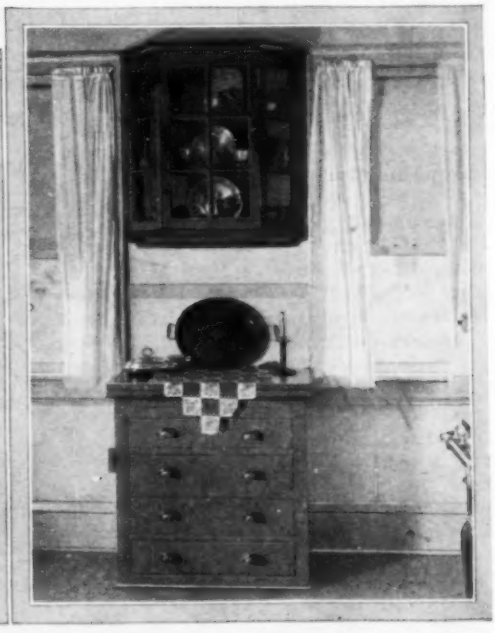
"The bureau," says Maurice I. Flagg, director of service, "has grown from a modest beginning of an experimental nature into a nation-wide organization with a membership of about 200 architects. For the first time in the history of American home building, builders of small homes may now have many of the advantages of professional architectural service at low cost. What are these advantages, and why are they offered to the home building public at a price, in many cases, perhaps ten times less than the same service would cost if it were supplied by an individual practicing architect?

"For a great many years the little house has been a big problem for the average architect. It costs about as much to prepare drawings and render service on a small house as on a large dwelling. The result has been, and is today, that many of America's foremost architects, as much as they would like to serve the small-home builder, are quite unable to do so, unless home builders are willing to pay a price for this service, which, under ordinary conditions, is more than the average builder usually feels he can afford.

"The result is evident on every hand. In nearly every city and town, thousands upon thousands of little homes have grown up overnight, entirely lacking the skill and professional touch of the trained architect. These houses have become a real menace to communities. They are not only unattractive in design, drab, monotonous and commonplace, but, nine times out of ten, they are wasteful and a hazard as far as an investment is concerned.

"The Architects' Small House Service bureau movement was originated in Minneapolis five years ago, a group of architects thinking along the same general lines deciding to try out locally a group of plans for small houses, and to offer these to the public at a low cost. Out of this experiment came an approval by the committee on small houses of the Ameri-

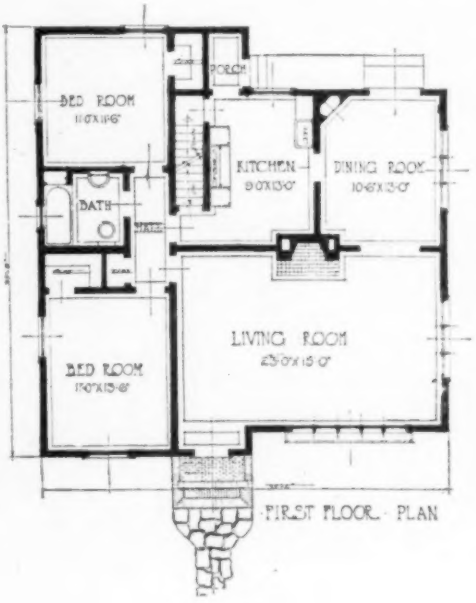




Above, Studying Small-Homes Plan Books; Below, an Attractive Vista of Hall and Living Room, and View of Kitchen, Both from Plans Available to Readers

Good Colonial Style, Full-Sized Rooms and Bath, Beautiful Doorway and an Attractive Fireplace Dominating the Big Living Room, Feature This House

can Institute of Architects. Later, as the bureau developed, it received the official endorsement of the institute, and finally, when the Architects' Small House Service bureau of the United States, which is the parent organization, was formed, the control of the bureau movement was taken over by the institute itself. The institute has no financial interest in the bureau, nor is it responsible for any of the individual acts of the members or any of the designs. It is a controlling body only, to insure that the bureau will not assume commercial aspects, and that its purpose will, at all times, be in accord with the professional practice and ethics of the architectural profession."



The bureau movement is the only agency of its kind in the United States operating with the endorsement of the department of commerce. Herbert Hoover, secretary of commerce, in giving that endorsement, wrote: "I have looked into the work of the Architects' Small House Service bureau of the United States with its divisions and branches and have examined its organization and incorporation papers. The complete plans, specifications, documents and bills of materials, with the

designs worked out for local conditions and to use stock materials and eliminate waste, materially simplify home-building problems.

"The form of control by the American Institute of Architects should guarantee a high standard of service.

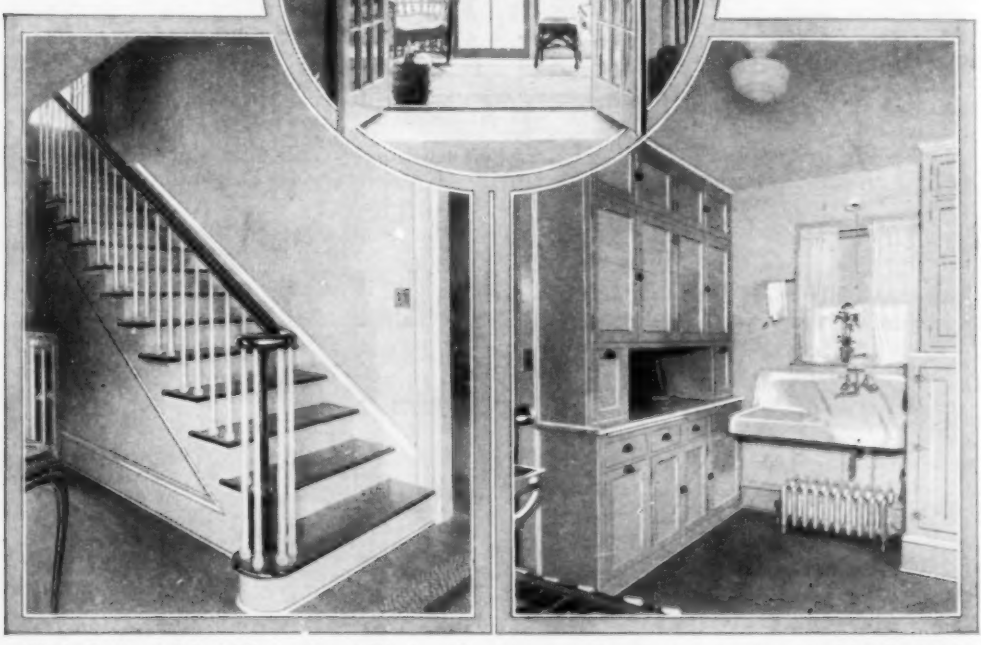
"It gives me pleasure to endorse this work and to assure you that the department of commerce will do all it can to co-operate with the institute and the bureau."

In arranging with the bureau to supply this service to Popular Mechanics Magazine readers, answering all their questions about home-building problems, and guiding them in their building operations, this magazine endorses the fundamental idea of the bureau. Its sole interest is the desire to improve the architecture of the small house in America, to eliminate waste in the building thereof, and to insure good, safe and at the same time, economical homes.

The bureau is practically a non-profit making organization, whose members are professional men that have no ax to grind nor interest, in any form, in building material or supplies. The plans which are offered to Popular Mechanics readers are complete professional drawings, prepared by various architects, and sold to the bureau at the usual fee commanded by their creators. The bureau in turn, by reproducing them in large quantities, is able to supply them with complete service, counsel and advice at a nominal charge.

The plans used to illustrate this article are typical of those produced by the bureau architects, and each is accompanied by a photograph of the house, as it appears when actually built by some home owner who has availed himself of the service offered. Architects' sketches and wash drawings cannot convey as accurate an idea of how a house will look when completed as these photographs.

All of the plans are featured by compactness of design, with maximum attention to lighting, convenience and ventilation. Dining alcoves, kitchens scientifically planned to eliminate waste steps, modern laundries, plenty of closets—these are some of the things provided. In the majority of the plans offered by the bureau care has been



Finely Designed Colonial Stairs, French Windows Opening onto a Sun Porch, and a Compact, Well-Equipped Kitchen from Architects' Small-Homes Plans

Tudor and Elizabethan Styles Combined in Attractive Six-Room Home

taken to provide two exposures, with cross ventilation, for every bedroom.

The plans are also marked by their artistic combination of materials—weathered woodwork, tinted stucco, tiles in variegated colors, or colonial combinations of white and green.

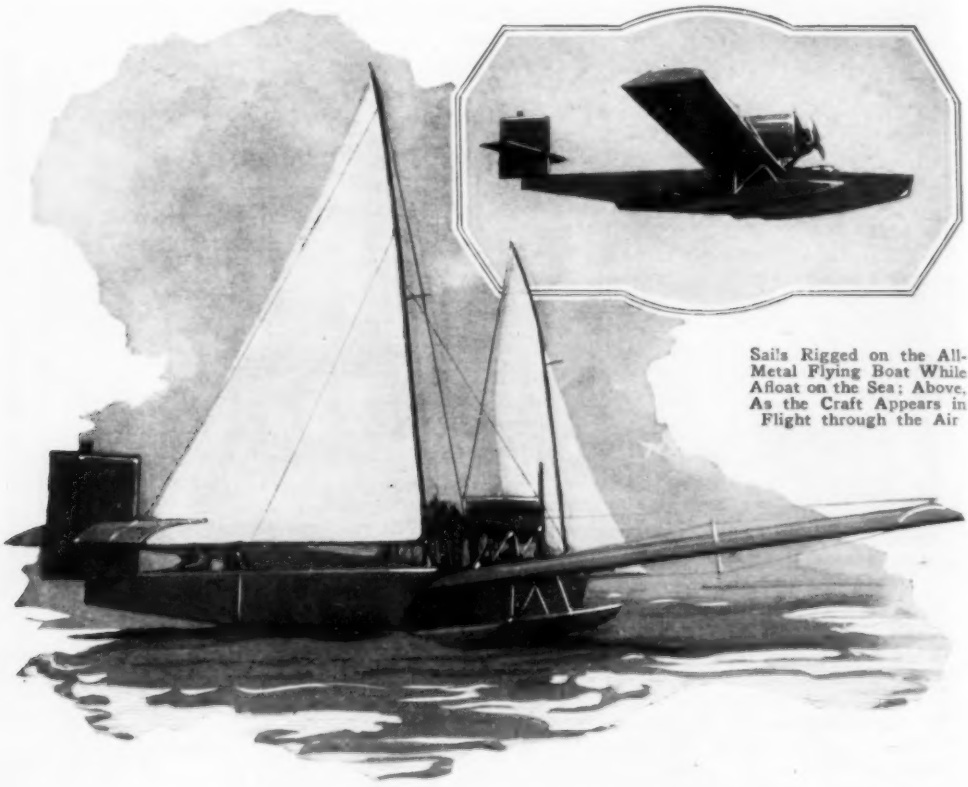
While the architects' bureau does not design special houses for any individual, minor changes may be made in many of the plans offered to conform to individual desires. The bureau will not make changes which would injure the durability or good design of a house, but will redraw designs to relocate doorway, omit or add a partition, or add or subtract a porch, pantry, or breakfast nook, if possible and desirable. Many houses which are shown with shingle or clapboard exterior may be as readily finished in stucco or brick, or vice versa. Advice in planning such changes is given free, and any necessary drafting can be had at the cost of the draftsman's time.

The bureau also is in position to furnish reversed blueprints in order to give the proper exposures for a house designed to face south, if it is to be built on a lot facing north, and so on. Such blueprints are furnished without extra charge.

Each month a new plan with picture of a house actually built from it, will appear in this magazine, and from time to time Robert Taylor Jones, technical director, will contribute articles covering home-building problems.

FIRST FLOOR

SECOND FLOOR



Sails Rigged on the All-Metal Flying Boat While Afloat on the Sea; Above, As the Craft Appears in Flight through the Air

METAL FLYING BOAT HAS SAILS TO AID CONTROL ON WATER

With an equipment of collapsible masts and sails that can be rigged up in a short time, an all-metal flying boat manufactured in Denmark, affords greater control when riding the water during bad weather and economizes in the use of fuel required to drive it to and from its mooring. The craft is constructed throughout of "duralumin," an extremely light but strong metal. The design of the framework is similar to that employed in bridges and shipbuilding, resulting in a powerful body, capable of carrying a much wider wing span than is usual in boats of this class. It is of the monoplane type with large metal pontoons fitted under the wings near the fuselage, to insure sufficient support while resting on or traveling through rolling seas. The machine is propelled by two engines installed above the wings and raised clear of them by metal supports. This arrangement of the twin driving units is claimed to make maneuvering with but one motor operating an easy matter. At ground levels the flying boat is said to be capable of traveling at a speed of 124 miles an hour, and to be able to reach an altitude of 13,000 feet. Fully loaded the craft weighs six tons, and with three-quarters of this burden can fly with only one engine running without losing height, it is claimed. The wings are strong enough to permit workmen to walk to any part of them, an advantage of considerable aid in tying up at moorings or in other sea work. When the ship is to be beached, the wings are supported by two-wheeled trucks placed under each wing and secured by guy ropes. Water-tight compartments with closing doors for emergencies are constructed so the craft will remain afloat in water, even with two of the chambers flooded.

RUST CONVERTED INTO METAL RESTORES ANCIENT RELICS

Priceless relics of ancient metalwork turned to lumps of rust by the action of time, are being restored to their original shapes and colors by an electro-chemical process devised by Prof. Colin G. Fink of Columbia university. More than 600 objects of bronze, silver and other art metals, so corroded that they have defied

dentification, are said to have been successfully treated by the method. The corrosion is caused by faint electrical currents operating on the materials over a long period of years, and this effect is reversed in the process by subjecting the metals to stronger currents of opposite polarity. Fake bronze antiques which have been artificially aged by special treatment are also easily disclosed by the system. Where thin coatings of gold on specimens of ancient jewelry have been damaged by acids and chisels in attempts at restoration, the platings are said to be left intact by the electro-chemical method.

FISHING CAN FOR LIVE BAIT, TACKLE AND CIGARS

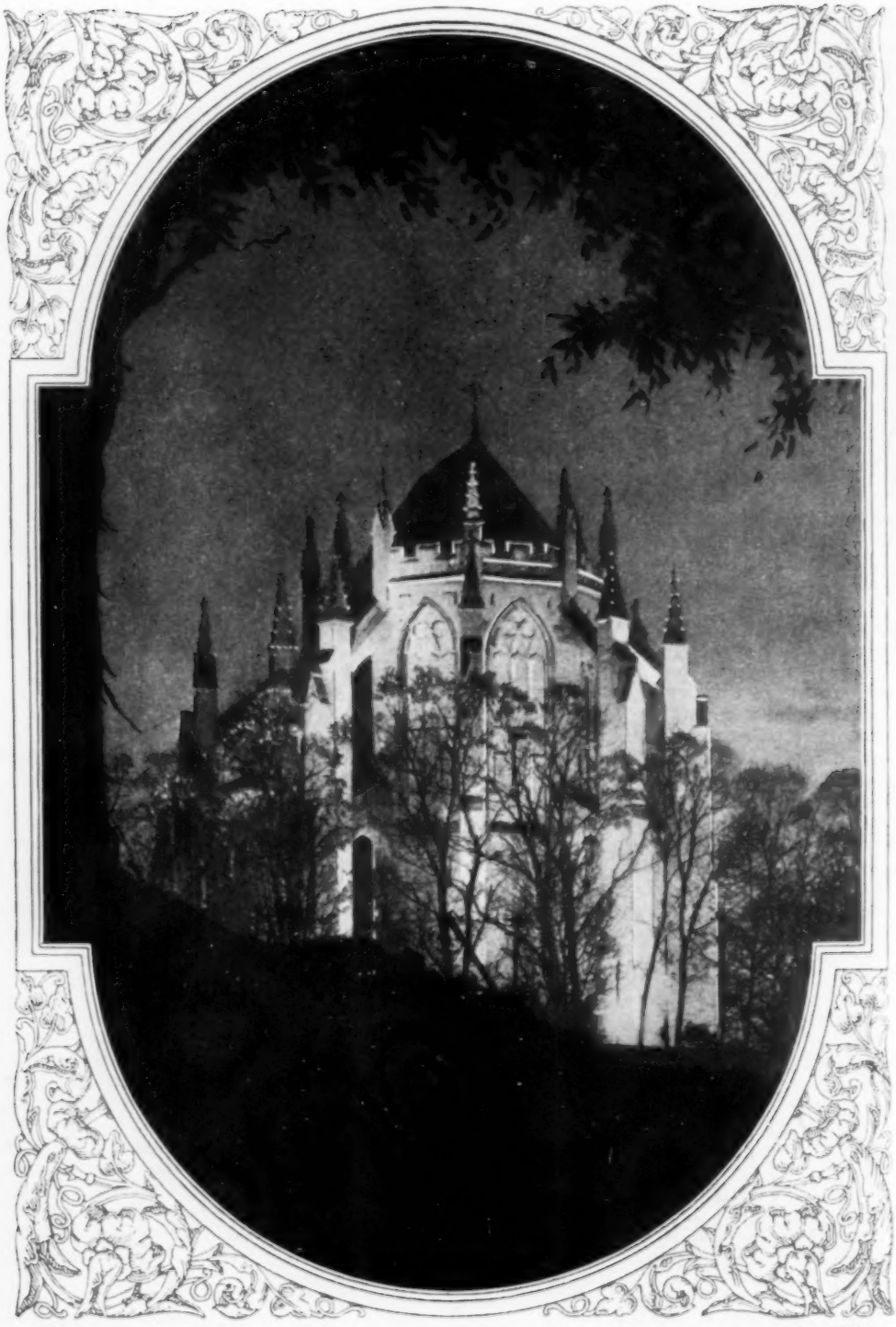
Live bait, and even cigars and matches, can be carried in a three-compartment container suspended from the fisherman's shoulder by a strap and always within easy reach. It is about the size of a gallon pail, is water-tight and will float. The main section is of zinc and has a cap that will not rust. There is an air space for ventilation and water can be allowed to circulate through if the can is to be used as a creel. Bait such as minnows, frogs and crawfish can be kept alive for a whole day's sport, in this large chamber. Two smaller compartments at the sides, also with tight caps, keep the tackle dry or may be used for matches and tobacco. The can is smoothly finished on the inside so that it will not scratch the hands, and the absence of sharp corners on the outside prevents its catching on branches when walking in underbrush.

Bait Cans in Use, and Inset Showing Compartments with Screw Tops for Cigars and Extra Tackle; Water Inlets Below

London "Bobby" Donning White Sleeves That Help to Make Traffic Arm Signals Easily Seen

WHITE SLEEVES ASSIST POLICE IN GIVING TRAFFIC SIGNALS

Guardians of traffic in London streets may be equipped with white sleeves so their signals can be more easily distinguished by vehicle drivers and pedestrians in congested districts. The cuffs, which reach to the elbows, may be removed when the officer is away from his station, and slipped on in a few seconds. Together with the white gloves now worn by the "Bobbies," the sleeves present a striking "flash" that can be seen for a great distance, and will enable traffic to perceive the policeman's arm movements more clearly when he is surrounded by pedestrians or partially hidden against a dark background. Less delay due to misunderstandings of directions is expected to result from the use of the sleeves.



© Henry Miller

Floodlights, Bathing the Already Finished Portion of the Cathedral, Hint at the Peaceful and Majestic Beauty That Will Glow from the Completed Structure at Nightfall

© Henry Miller

Modern Appliances Aid the Sculptors Who Are Carving, in the Stone of the Vaulting Aisles of the Cathedral, Symbols That Tell the Christian Story

Building for Eternity

Washington Cathedral, like Gothic Masterpieces of Europe, Is Planned to Last for Ages

IN view of the speedy erection of modern skyscrapers, why should so many years be required to build great cathedrals? This inquiry is often made, and knowledge of the answer brings a fuller appreciation of the beauty of Gothic architecture.

Modern office buildings are built for investment with immediate financial return. Their specifications call for the maximum space for rent, the smallest expenditure of money, and an imposing exterior. The floors are as nearly as possible duplicates of each other. A veneer of stone provides the desired front.

A cathedral, on the other hand, is not built for financial profit. It is built for eternity, primarily for the benefit of future generations. It is built of enduring stone, with ten times as much stone as would be necessary for a steel-and-stone structure of similar size. There is little duplication. Every part is different. Gothic architecture, especially, does not repeat. Every stone, carved window, arch, tower, and pinnacle is subtly varied. Thousands of pieces of sculpture and carving each tell a different story; every window is an individual work of art. There is an infinite gap between the building set up for the purposes of Mammon and the house of prayer erected to the glory of God.

The erection of any building can be divided into two parts, planning and construction. As much time is necessary for planning a Gothic cathedral as for building one. Congress granted a charter to Washington Cathedral in 1893. The architects have been at work on the plans since 1906. Today the architects estimate the remaining work will take at least five years. Endless refinements and subtle variations, careful mathematical computations necessary to meet the thrusts of the stone vaulting and the weight of the solid masonry, the designing and redesigning of models for the sculpture and sketches for the stained-glass windows, all of which must conform to the traditions of Christianity and the most comprehensive scheme of symbolism ever devised for a cathedral, require many years of planning.

Modern methods of construction, speedier transportation and improved machinery mean little in a cathedral enterprise. These must all be adjusted to the essentials of monumental building—the laying of brick, the setting of stone and its carving after being set in place. This is all hand labor, and in the performance of this hand labor we are today probably not as efficient as in the thirteenth century. The average workman is not as skilled, and there are fewer workmen of this class available. This point is illustrated by a recent incident. A workman with a reputation as a skilled mason was called from a distant state. He spent one day looking over the work at Washington Cathedral and then packed his tools and left, saying the work was entirely beyond his ability. American workmen are as good as any other; there is no necessity for importing men, in fact Washington Cathedral is an American cathedral in men, in material, and in ideals. The scarcity of skilled cathedral builders is world-wide and Washington Cathedral is now a training school for builders of the ancient standard of craftsmanship.

Naturally, the cost of erecting such a structure is great; but although the initial cost is about three times that of steel and stone, it will last ten times as long. The Church believes in investing for eternity. There is probably nobody who seriously contends that the cathedrals of Rheims and Seville, and the Westminster Abbey should have been built of steel and stone

Hours of Patient Handwork Are Required to Fashion Lace Out of Stone for Arching Gothic Windows, Revealing Why a Cathedral Cannot Be Built in a Day

Looking from the North Where Builders Are at Work Next to the Apse, Which Was Started in 1915, Is 147 Feet High and Forecasts the Beauty of the Whole; Below, Examining Some of the 1,000 Symbolic Figures That Will Illustrate Christian Precepts

© Henry Miller

veneer. They would have looked as well as a stone structure for the first fifty years, but after that they would have had to be rebuilt every hundred years. They would not have stood for 1,500 years as has St. Sophia in Constantinople.

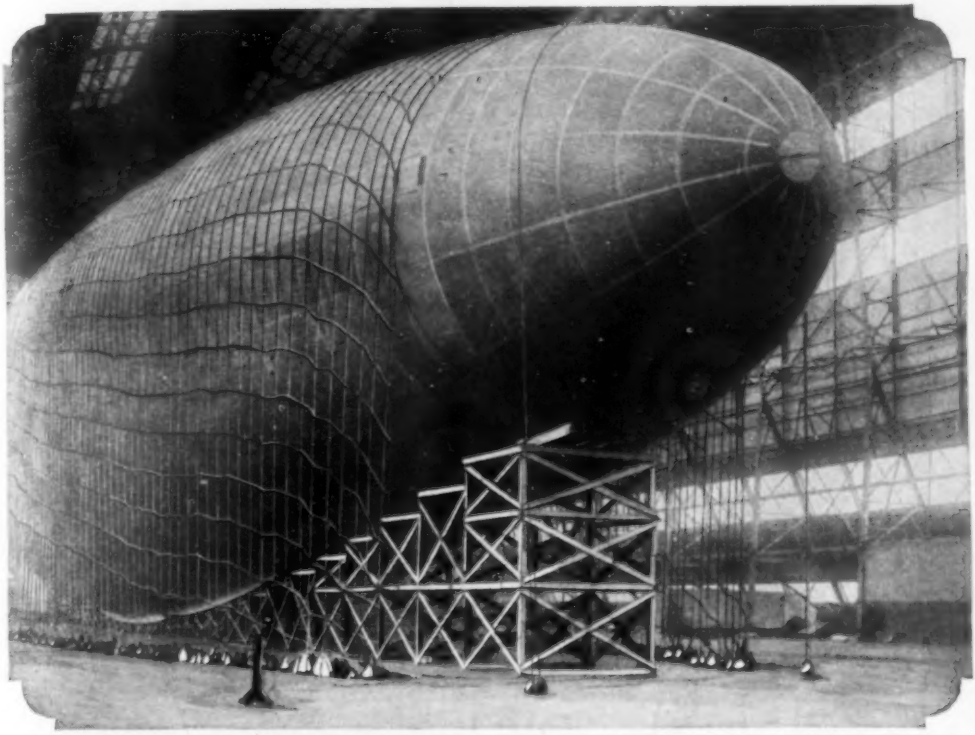
While it is the aim of the builders that the cathedral reflect the spirit of America, it is being constructed on strict Gothic lines. Every stone in it is essential to its strength. Like the great edifices of Europe, it is laid out in the form of a cross, the arms of which will constitute the north and south transepts, each with an entrance. Beneath the south transept, will be the chapel of the Resurrection, a crypt of Norman architecture. The central tower of the cathedral will be 262 feet high and as the building occupies a commanding site 400 feet above the level of the city, the top of the tower will be 107 feet higher than the Washington monument. The completed structure will be 534 feet long, 29 feet more than the length of Westminster Abbey. It is estimated that it will cost $10,760,000.

Building of the apse, which is 147 feet high, commenced in 1915. It will contain the sanctuary. In 1922, the foundation outside was begun and was finished in fifteen months. It contains 422,000 cubic feet of concrete into which went 9,000,000 pounds of cement, 10,000 tons of sand and 18,000 tons of gravel. It contains a labyrinth of passages, store and heating rooms and places for workshops. The cathedral is being erected on a densely wooded spot and it was necessary to cut down many of the trees. A number of the oaks that grew here are being carved to form the stalls and woodwork of the choir. The great church will be the central structure in a group of other buildings, including a number already finished and about thirty that are being planned. Among the latter are houses for retired clergymen, an administration building and additions to the boys' and the girls' schools that now share the site.

Washington Cathedral is being built for the ages. It is one-ninth completed. The Bethlehem Chapel, beneath which Woodrow Wilson is buried and from which are broadcast the services every Sunday afternoon, is in the apse, underneath the main floor of the cathedral. The aim of the edifice is to express the nation's religious faith in the most artistic manner in accordance with the ideal of spiritual beauty, and much exquisite sculpturing already has been done to carry out its scheme of symbolism. Some day, when the Cathedral Close is built up with thirty more buildings and is surrounded by a wall with twelve gates, it will justify the description —a Holy City on a Hill.

Shaping Large Pieces by Machinery, an Operation Possible Only on the Plain Units; Each Is Cut, Molded and Numbered Before It Is Shipped from the Quarries to the Builders at Washington

ARMY DIRIGIBLE TO ACT AS CARRIER FOR PLANES



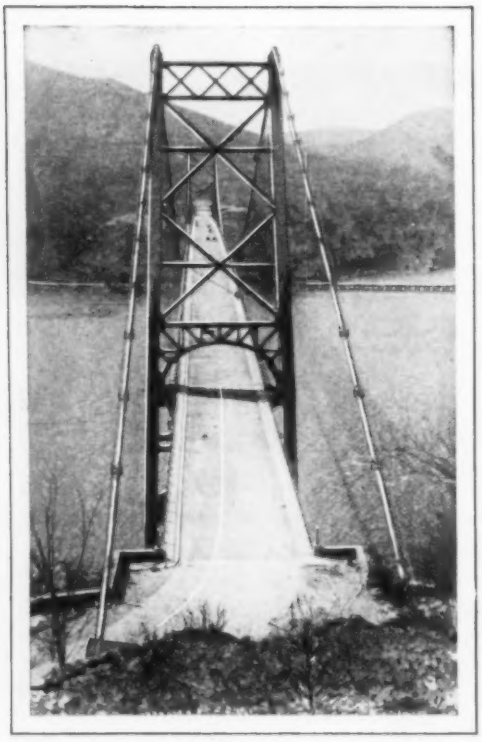
Bag of Airplane-Carrying Dirigible in Hangar, Held Down by a Net Slung over It and Tied with Weighted Bags; Car and Apparatus for Planes Are under Construction

Encouraged by the performance of the massive dirigible airships "Shenandoah" and "Los Angeles," the army air service is completing the first semi-rigid craft to be built in this country. The ship, "RS-1," is designed to afford a high factor of safety under all conditions, its ability to perform difficult maneuvers being a secondary purpose. The newest giant of the government air fleets is 282 feet long and has a capacity of 719,000 cubic feet of helium gas. It will be driven by four 300-horsepower motors, capable of producing a speed of 70 miles an hour, with an ordinary cruising velocity of fifty-five miles an hour. The airship will be employed as a mothership for airplanes, being equipped to carry them to their areas of operation.

Tending the Portable Oil-Burning Tar Melter in Auto Truck for Quick Roof Repairing

OIL-BURNER FOR MELTING TAR CUTS COST OF ROOF REPAIRS

Pitch and tar for repairing roofs are melted in an oil-burning heater that eliminates littering the streets with scrap wood and ashes. It is rigged in the rear of a small automobile truck. Solid lumps are put into the melter at the top, and the melted material is drawn off through a spigot. There is a sixty-gallon tank to hold the fuel supply, and air pressure of thirty pounds is maintained by means of a hand pump.



Massive Suspension Bridge over Hudson River near Albany Which Joins Busy State Highways

SIX MILLION DOLLAR BRIDGE JOINS MOUNTAIN ROADS

Built at a cost of $6,000,000, the Bear mountain bridge over the Hudson river near Albany, N. Y., has a roadway wide enough to accommodate four lines of vehicles, or a capacity of 5,000 an hour. The structure, which is of the suspension type, has a central span 1,632 feet long. It connects the sections of one of the state's important highways, and stands 150 feet above the river. Though situated in a mountainous country at a sparsely settled point, the bridge is elaborately equipped with electric lights and sidewalks for pedestrians.

MODERN BURNING BUSH SEEN BY WYOMING CAMPERS

Rivaling the biblical story of the burning bush, an experience with static electricity related by three Wyoming motorists, left the victims almost smothered when the charge caused acres of sagebrush to become luminous. According to the travelers, they were enveloped in heavy charges of static electricity while camping for the night near the foothills of the Big Horn mountains, and awakened from sleep by their inability to breathe in the still, dry air. Large patches of surrounding vegetation were lighted up by an unconsuming flame which apparently gave off no heat and but little light. Almost smothered, one of them attempted to crank their car, and received a severe shock as sparks leaped from his fingers to the metal. No amount of effort could start the engine of the car, and trapped in the suffocating atmosphere, in which they could detect a distinct odor of sulphur, they painfully labored for breath for about ten minutes, when a wind arose and drove the charged atmosphere from the area.

JAZZ HORN REQUIRES NO SKILL AND SOUNDS LIKE TROMBONE

The "Swanee sazzafone," an instrument for playing jazz music, introduced in England for use in either orchestra or solo work, does not require a trained artist and can be played by anyone able to hum a tune. Equipped with two bells, the device is said to produce the effects of a muted trombone or trumpet. There are no keys on the instrument, the player forming the various notes and tones through the mouthpiece. Since the horn may be played without the need of printed notes, it can be used in connection with other instruments by a performer unskilled in music and does not necessitate long practice to master its operation.

Playing the "Swanee Sazzafone" Which Sounds Like a Trombone and Requires No Musical Skill

By CORLEY McDARMENT

ONE bright afternoon at a flying field near Washington, a large crowd had gathered to witness an aerial circus. The ordinary flying stunts were carried out and the people marveled, but there were no outbursts of enthusiasm because most of the tricks had been done before and nearly everybody had seen them.

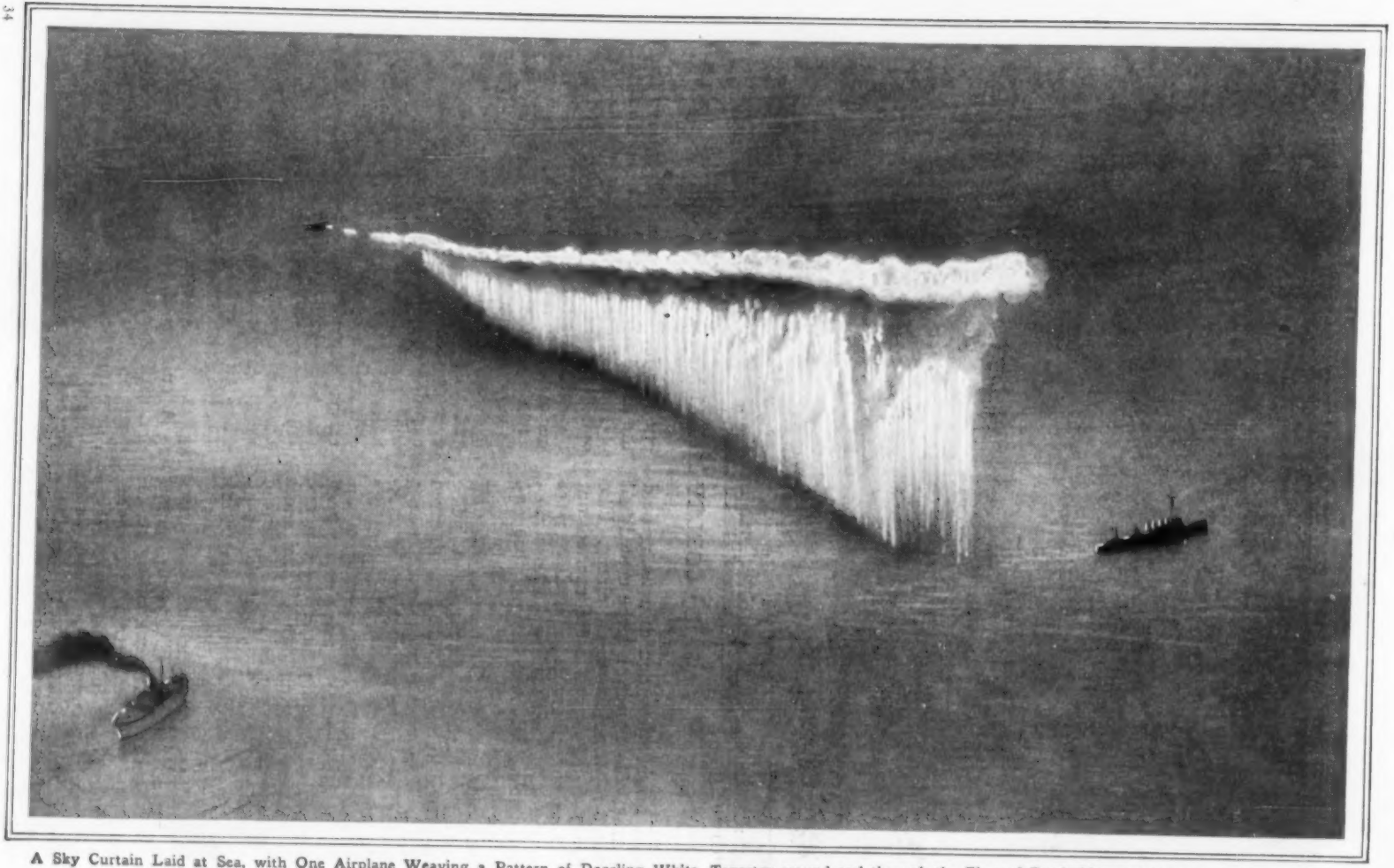
But suddenly a speck appeared away off against the blue sky background. The stunt planes hurriedly landed and cleared the field. The speck grew into a speeding plane. When right in front of the spectators, the machine dipped almost to the ground, then quickly the nose went up. At about 2,000 feet, the machine whipped over on its back, came out level again, and after making a wide circle, once more headed for the flying field. This time it flew level, and when opposite the spectators, a most uncanny thing happened. The people gasped in silence.

From beneath the machine snow-white vapor began to spout. This vapor, spreading out like a fan, began falling to the ground like a magic curtain, and instead of crumpling and blowing away, stood upright as if strung upon solid wires. This was the newest type of smoke screen that modern science has developed, a new element in human affairs and a factor for good or for evil, depending entirely upon the moral attitude of the people who use it.

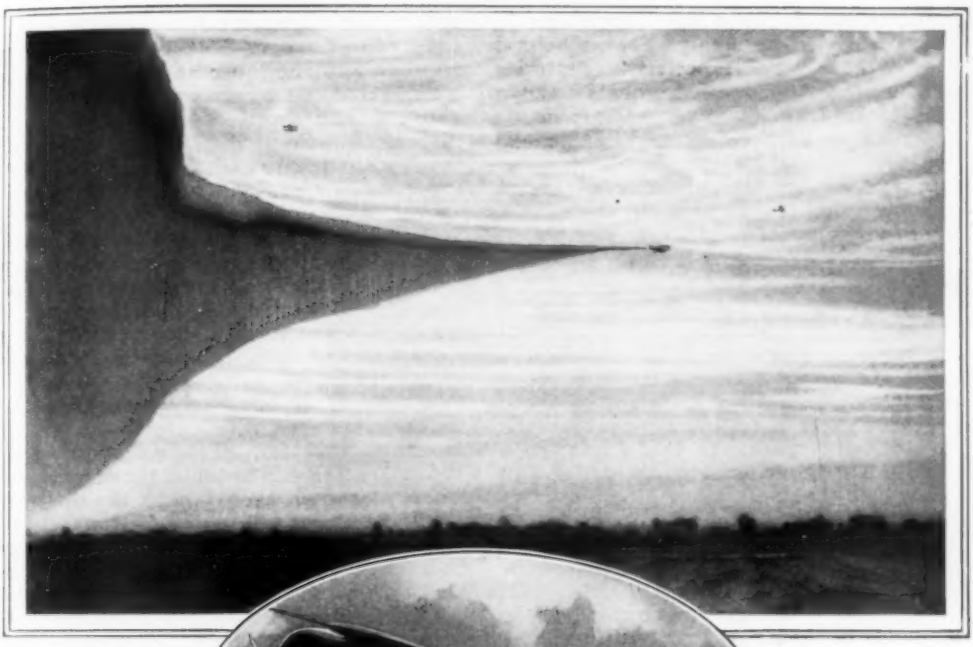
Quietly in the laboratories of the great world powers, scientists have been peering into test tubes and carrying out experiments in an endeavor to perfect a curtain that could be hung in the sky. It is now a fact—a dream come true—and it is an offspring of aviation, the latest and most spectacular invention mankind ever concocted. Without airplanes, sky curtains could not be hung from horizon to horizon in less time than it takes to write about it.

Within a small box that one man can carry, enough curtain-making material can be packed to screen a whole city, an entire army or a whole fleet of battleships. One airplane can easily fly with such a load. And with airplanes traveling at 200 miles an hour and over, little chance exists to stop an aerial curtain hanger with guns.

A curtain of white chemical makes a beautiful thing to look upon when dropped from an airplane, but it was certainly not for entertainment that it was developed. The chemicals that go to make up a smoke screen are a deep secret. Each foreign country has its own mysterious preparation on this line.



A Sky Curtain Laid at Sea, with One Airplane Weaving a Pattern of Dazzling White Tapestry around and through the Fleet of Battleships and Destroyers, Cutting Them Off from the Rest of the World



Airplane Laying a Protecting Black Screen across the Sky; Below, a Craft of the Kind Used to Lay the Curtain

"It has a phosphorus base," is the answer to all queries given by those who are intrusted with these government secrets. That is something, however, anybody who has ever studied chemistry could guess, and the answer is harmless as well as valueless. Some chemists will go so far as to name several of the other ingredients of the curtain mixture, but nobody is putting out the proportion of each element used and without this knowledge, an experimenter might well spend a lifetime trying to put them all together in just exactly the right ratio for a closely woven sky curtain. The big screen itself, when dropped, cannot be picked up and examined, for it would be like scooping fog on a London street, or gathering smoke in Pittsburgh.

If the screen has not been developed for pleasure, the only other excuse is business. Business is exactly what it is for—the business of war. When the Great War closed, the smoke curtain had not begun to be used to any large extent, but it was being worked upon, and chemists were sweating day and night in an effort to add this little contribution to the unpopularity of modern warfare. The war ended prematurely for this display, but the work continued and now it is an ax behind the door in international affairs. A few years after the war, some Englishmen began to use a sort of modified smoke screen that issued from an airplane through a special apparatus and made a long streak of black smoke which hung in the air. This was used to do skywriting for advertising purposes and is still used extensively.

But the primary object of the smoke screen was and is to conceal something. Battles have always been won by one commander having something up his sleeve that his opponents did not know about; in other words, a surprise. Nothing in the world can help put over a surprise in combat like one of these sky curtains. Heretofore cavalry has been used to screen movements of troops on foot, but horses going at a gallop are not one tenth as fast as airplanes, and besides, cavalry cannot shut off the view of observers stationed on hill tops.

The only way that a commander can see beyond a sky curtain is to get into an

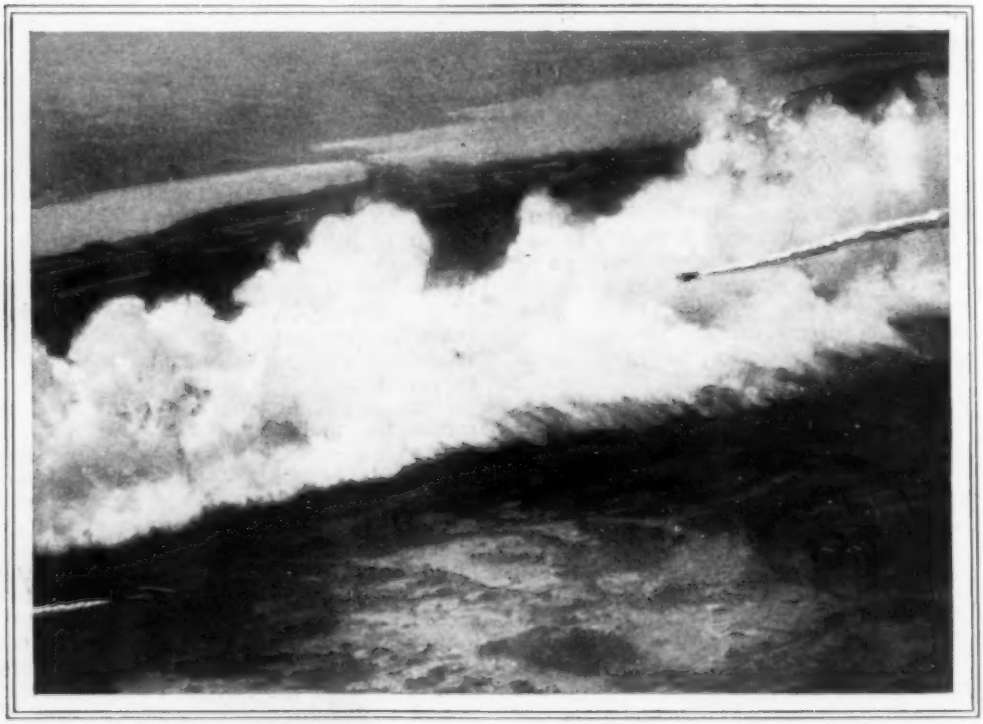
airplane and fly over it. Everything in future wars will probably be done behind one of these aerial tapestries. Batteries will be drawn up, reinforcements thrown in, attacks launched and retreats made under cover of the impenetrable smoke screen.

In making an attack under a screen, superior forces could be upon the enemy before he knew it, and a surrender would be the approved and conventional consequence. The enemy could shoot through the screen only at random, and batteries of heavy guns would be useless without the gunners being able to "spot" the shots. Of course, the thing would work both ways. The enemy could do all these things too and the winner would be the side that got around to the matter first. It will make war more a game of wit and agility than ponderous, expensive campaigns.

An airplane can fly through one of these curtains, standing up like a thin roll of absorbent cotton, without breaking it down. The propellers make a whorl in the white vapor and the path of the plane can be seen after it is through, but the mist closes in so it is impossible to see through it. It has been rumored a way to precipitate these curtains has been discovered in Europe. This would be to turn another airplane loose and have it attack a smoke screen by flying lengthwise just above it and drop chemicals that would disperse it. Something like this may be done. But the job of cleaning up one of these five or ten-mile screens would be an enormous undertaking.

One big feature of the curtain is its sticking qualities. It does not disappear like smoke in the wind but hangs for many minutes. On a still day, traces of it may be seen for an hour after it is dropped, and for about thirty minutes it makes a haze.

A new terror has lately been added to the smoke screen which makes its importance still greater. That is poison gas. When the curtains are laid, they stand upright, as stated, then fall to the ground. But they do not fall flat where they stand. They spread downward and become a blanket, and when this happens, the people on the ground are not only blinded but poisoned as well! So it is small wonder that attempts are being made to set up some kind of an international court where differences can be settled with speeches and a gavel.



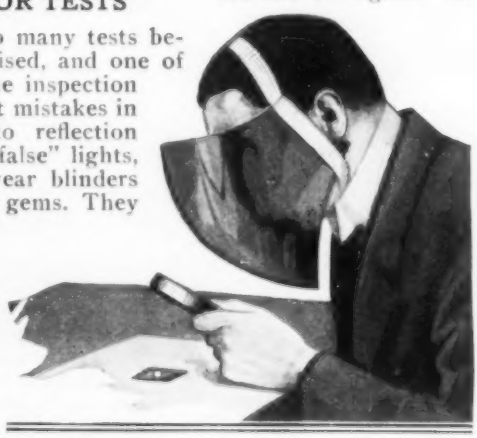
Two Airplanes Traveling in Opposite Directions Can Lay a Double Screen, One Falling as the First Begins to Disperse

GROWTH OF THE PATENT OFFICE IS SHOWN BY FIGURES

From a force of one clerk ninety years ago the patent office has grown until now it has 1,250 employes. During the past thirteen years as many patents were issued as were allowed for the first fifty-seven years of the department's existence, and in 1924, every state in the union and more than sixty foreign countries were represented among the masses of successful applicants. An average of 80,000 applications for patents is received yearly, and this government has issued about one-third of the 4,800,000 patents recorded for the whole world, the report says. A collection of 150,000 models is in possession of the bureau, although since 1880 they have not been required as part of an application except in unusual cases where mere pen work is not sufficient. Two fires, one in 1836 and the other in 1877, destroyed great numbers of the earlier models gathered in the bureau. The activity of modern genius resulted in loading the office with a waiting list of over 75,000 applications for patents, but by adding to the clerical force, this volume has been reduced to 52,000, handled at the rate of 2,000 a month.

PEARL SORTERS WEAR BLINDERS TO HELP IN COLOR TESTS

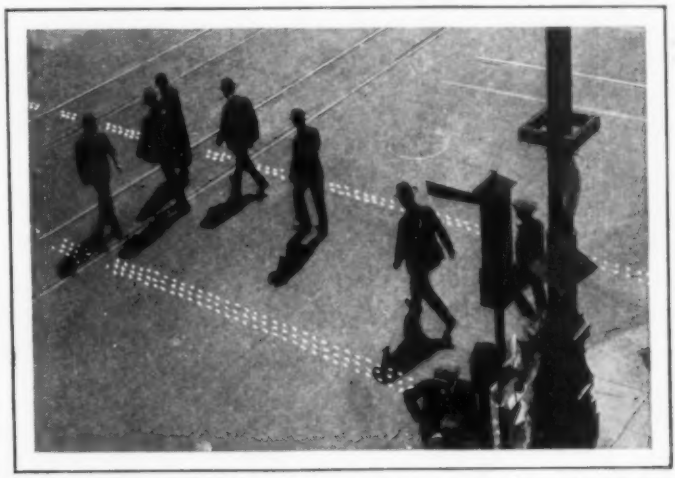
Pearls are subjected to many tests before their value is appraised, and one of the most important is the inspection of their color. To prevent mistakes in this examination due to reflection from other surfaces or "false" lights, the sorters sometimes wear blinders to shield the eyes and the gems. They are attached to the head by a band under the chin and extend close to the magnifying glass under which the pearl is scrutinized against a dark background. The true color and texture of the specimen are revealed and flaws more readily detected.



Pearl Sorter, Shielded by Blinders, Examining Gem with Magnifying Glass in Color Test

SPIKES AS TRAFFIC-LINE MARKS SAVE COST OF PAINT

Large copper-headed spikes driven into the pavement to mark traffic lanes, are proving a satisfactory substitute for paint in a western city. They are more durable and, once in place, need no attention. Wheels passing over them keep them bright, and they do not protrude far enough to hamper traffic.

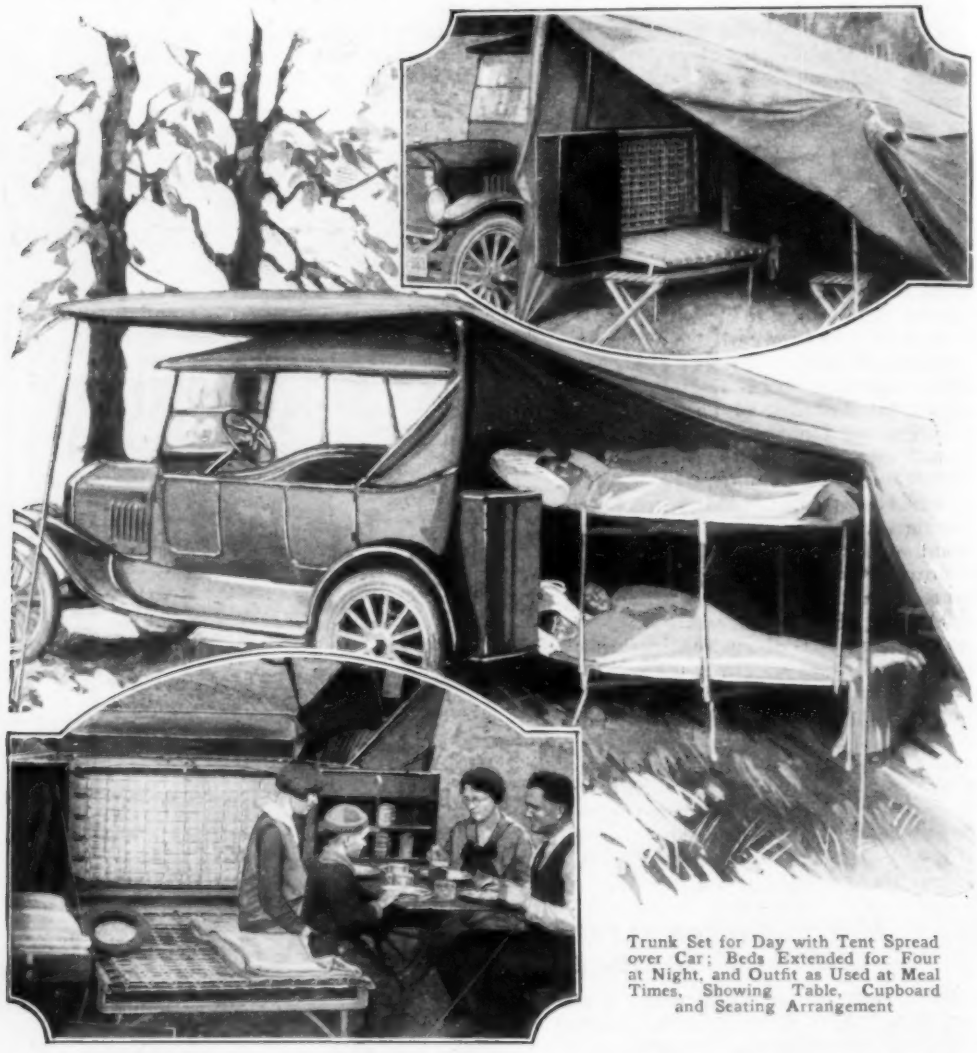


Rows of Copper-Headed Spikes Driven into Pavement at Street Intersection to Mark Traffic Lane for Pedestrians

TIRES MADE TO ROLL FARTHER BY CHEMICAL RESEARCH

Chemists are saving the motorists of the country $50,000,000 a year on their tire bills and the manufacturers about $40,000,000 annually, it is estimated, through the use of organic "accelerators" in rubber so that vulcanizing can be done in from one-third to one-fifth the time formerly required. Largely due to other chemical discoveries, tires are now made to cover from 15,000 to 20,000 miles before they have to be replaced. Twenty years ago, the average running life of a tire was about 2,500 miles.

AUTO CAMPING TRUNK HOLDS BEDS AND TABLE



Trunk Set for Day with Tent Spread over Car; Beds Extended for Four at Night, and Outfit as Used at Meal Times, Showing Table, Cupboard and Seating Arrangement

Essentials of a camping equipment for four persons are carried in a folding trunk that fits the rear or the side of the automobile, weighs but 175 pounds when filled, and may be detached from the car or put into use without removal. It holds two double all-metal spring beds with pads, a frame for supporting a tent over the outfit, cupboard with space for a small stove, utensils and provisions, and a table, besides room for wardrobe and extra bedding. The trunk can be locked even with the tent over it, assuring safety when the tourists are away. The lower bed forms a seat and both bunks have strong legs. Since it is not necessary to remove the trunk, time is saved both in packing and unpacking.

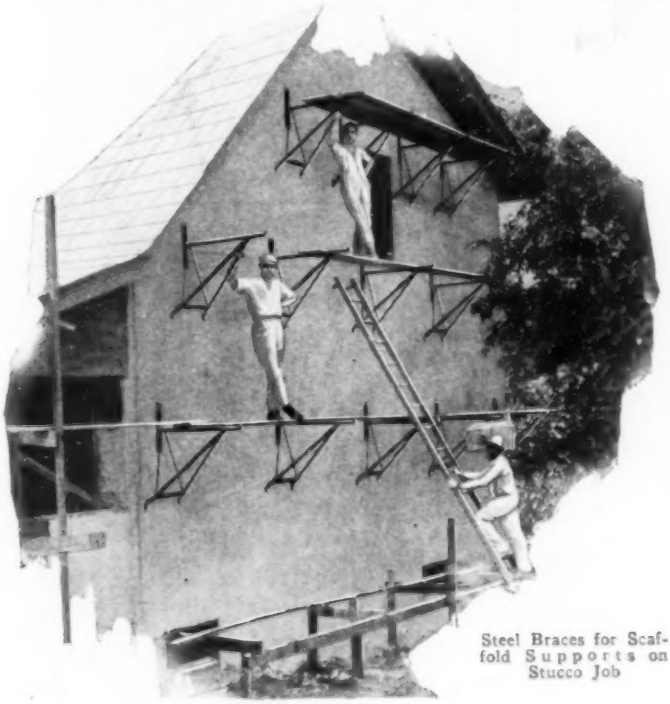
FREAK CANES GROWN ON TREES BY TWISTING BRANCHES

To meet the increased demand for fancy walking sticks, French farmers train the branches of young trees to grow into grotesque shapes. Maple, birch, chestnut and ash are the woods best adapted to the purpose. At the end of the first year, the trees are cut short so that they produce new shoots at the bottom. These are twisted into various forms, secured by cords until fully grown and sometimes

carved while still on the trunk. Fresh trees are planted to insure constant supplies. The sticks are commonly sold for $1 to $20, but more artistic designs occasionally command $50 and even more.

STEEL BRACKETS FOR SCAFFOLDS

Steel braces that are attached to the wall with four nails and have two legs that rest against it to keep them from shaking, have been found practical for stucco and other construction jobs. They can be set up in much less time than is required for the usual wooden staging, are made of steel that will not bend, and fold up for easy carrying. They are manufactured in two lengths, three and three and one-half feet, weigh less than 200 pounds per dozen, and are said to last indefinitely if properly handled. A dozen or two of the brackets, it is said, will take care of the average stucco job.



Steel Braces for Scaffold Supports on Stucco Job

Man at Right Is Wearing the Tiny Ear Phones Which Are Connected to Amplifier Apparatus in Box on Chair

MIDGET PHONES FOR THE DEAF FIT WITHOUT HEADBANDS

Persons who are partly deaf can hear almost perfectly, it is said, with a set of tiny telephone receivers operated in connection with two small microphones and an amplifier with two vacuum tubes. No headband is necessary as the phones, about the size of the end of the thumb, are fitted into a molding that conforms to the shape of the ear so that they can be held securely and without discomfort by the ear itself. The entire outfit, with batteries included, is portable and can be concealed with little trouble.

PLANT TO COMBAT MOSQUITOES

By grafting shoots of cinnamon or cloves upon a plant known as "holy basil," a European botanist is said to have produced a shrub whose leaves render mosquitoes insensible within a few seconds after the insects touch them. The leaves are said to aid in combating malaria, while their use in the daily diet wards off certain diseases.

Inventor and His Camera That Takes Pictures of the Sun for Guidance of Aviators

CAMERA SERVES AS SEXTANT TO DIRECT AVIATORS

As an aid to aerial navigation a camera sextant has been invented by Lieut. Com. Maurice R. Pierce, navigator of the dirigible "Los Angeles." It serves the same purpose as the familiar instrument mariners have used for generations to find their location by the position of the sun, but it overcomes two problems that often harass the aviator particularly, a hazy horizon and the lack of time. In operation, it is pointed at the sun, the shutter is pressed, and in a minute, the negative can be developed in a series of rinsing and fixing tanks built into the sextant case. The film is then placed under a celluloid scale and the correct reading obtained to a fraction of a second of degree. Two spirit levels form a right angle about the finder enabling the operator to hold the camera level. The inventor expects to include an attachment that will automatically register the exact time when the exposure was made, and use of the camera sextant at night also is predicted.

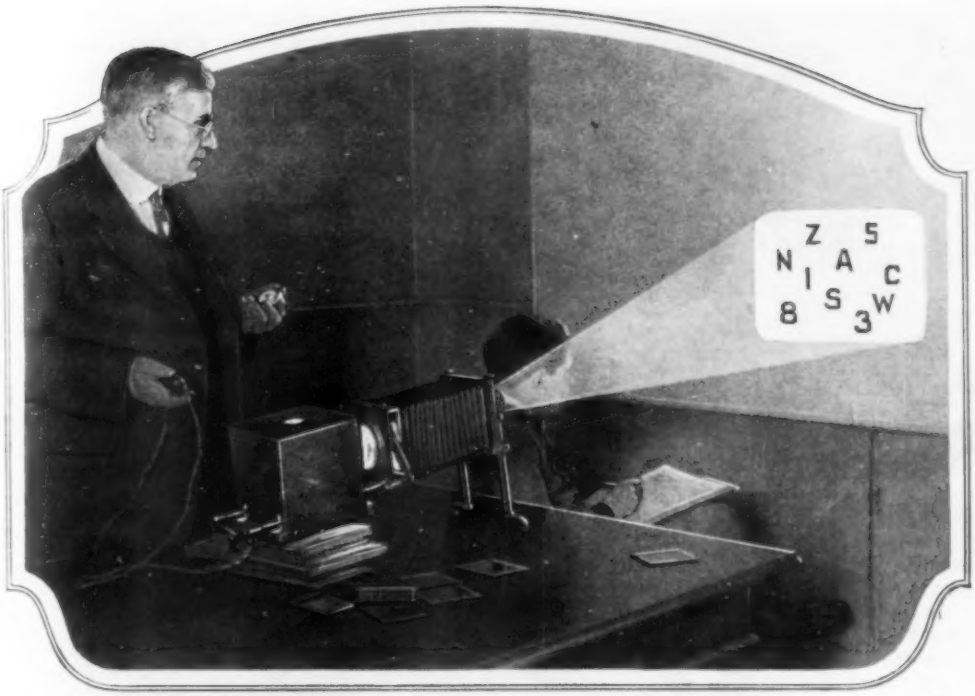
HIDES TANNED BY ELECTRICITY TO SAVE TIME

By an electric process now in use in Germany, green hides are turned into finished leather in about one half the time required by usual methods, it is reported. The hides are soaked, scraped and prepared in the customary manner, then hung on rods in a pit containing the tanning liquid. At both ends of the vat are groups of electrodes. For eight hours, current is passed through the bath, driving the water from the fibers of the hides, allowing the preparation to soak through thoroughly. The skin resembles a squeezed sponge when it is taken from the pit and is in such condition that the next tanning material is absorbed rapidly.

SAILBOAT WITH TWO HULLS KEEPS BETTER BALANCE

Built upon two pontoons bridged together, a novel sailboat devised by Italian enthusiasts is said to have a safe speed of twenty-four knots in brisk winds, to keep better balance than ordinary models and to be practically non-capsizable. When one side rises clear of the water, the other remains securely on the surface. The pontoons practically act as outriggers, but do not interfere with handling the boat, and when the craft rides on a single float, head resistance is decreased, it is claimed, especially in rough seas.

Riding High and Dry on One Hull, While Other, Nosing into the Water, Holds the Craft Steady



Testing Visual Memory; for Three Seconds, the Child Looks at the Slide, Then the Light Is Snapped Off, and He Writes Down as Many Letters as He Can Remember

How Much Musical Ability Have You?

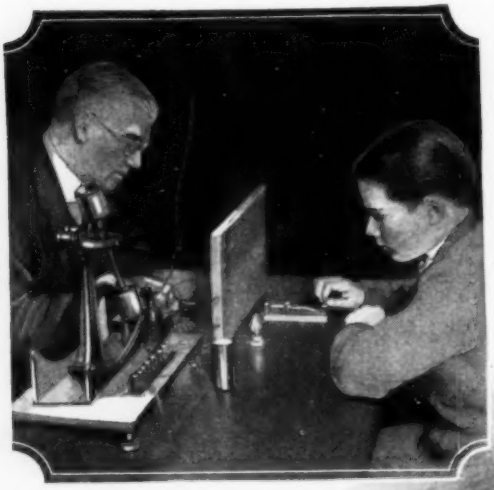
Tests with School Children Show That Only One Out of Four Has Exceptional Ability and Many Almost None

By PAUL PADDOCK

BELIEVING that more money is wasted on music lessons every year than is spent on all kinds of technical education put together, instructors at Northwestern University are using a series of instruments to test musical ability. Between 4,000 and 5,000 grade pupils at Evanston, Ill., already have been given these examinations.

Only about one out of every four pupils taking the first five elementary tests from phonograph records, as devised by Prof. Carl E. Seashore, of the University of Iowa, it is said, showed marked musical ability warranting further diagnosis by means of the advanced examinations. The phonograph tests are designed, briefly, to show sense of pitch, time, rhythm and memory. They are given in the schoolrooms before the pupils go to the university laboratories. Fully half of the students get a grade between seventy-five and fifty. A fourth of the pupils make such a poor showing that the instructors believe they have practically no natural ability, and that, therefore, time and money spent would be wasted.

The advanced tests are given to one pupil at a time, under the direction of Prof. E. E. Jones, of Northwestern University, who has suited them to the purpose of finding out more about the child's musical gifts than can be discovered by the first tests, and if he has special adaptability to any one particular instrument. It is not claimed that the results of any of the tests are final, but they serve to weed out most of those who have little talent for musical development and to encourage those who have genius. Some pupils, it has been found, have eighty times as much ability as others. There seems to be little difference in talent between the sexes. For three years, a girl



has received the highest grade. A boy has stood at the head for four years. The rest will have about the same average. Alertness and power of concentration are determined by a pendulum arrangement that shows the pupil's skill in terms of thousandths of a second. The child sits at one side of a table before a tiny electric light and puts his hand on a telegraph key. Opposite him is the examiner, an experienced assistant to the director. "Get ready," says the instructor. As he speaks, he pushes a switch, the little light flashes at the same instant, and the pupil's object is now to press the telegraph key. This halts the pendulum at a figure that shows just how much time has elapsed between the flashing of the light and his touch on the key. Next, the subject is blindfolded so he cannot see the light or watch the examiner, and is told to press the key as soon as he hears a buzzer that is set off the instant the pendulum is released. With the blindfold still on, the same process is repeated; this time a tickling sensation on the finger made by a little steel bar that vibrates rapidly, being the signal to touch the key. There is no way to "beat the gun" in this test, for if the child presses too soon, nothing will happen, since the pendulum must be released by the examiner who controls the starting.

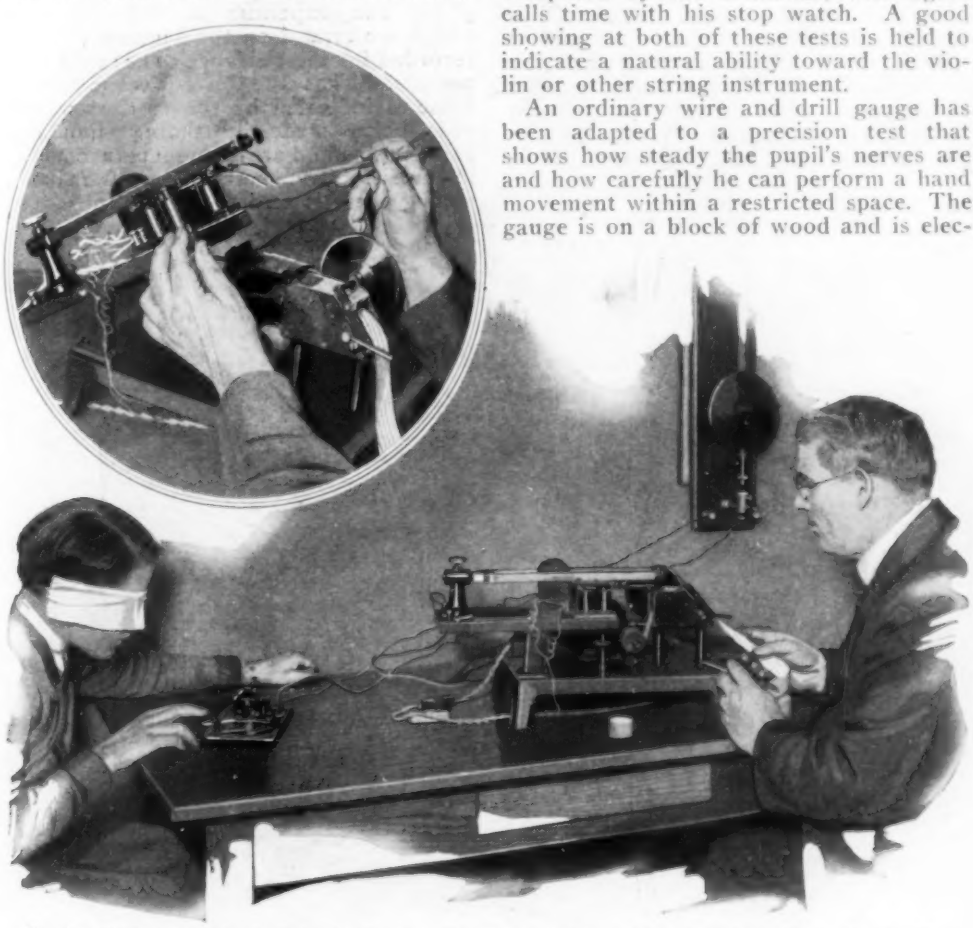
Another pendulum test awaits the student in the next room. This shows, by a written record on a strip of waxed paper, how well or how poorly the pupil can keep time. His errors are shown in fiftieths of a second. Each child gets twenty chances at this, ten with the help of a buzzer that sounds as the pendulum ticks off the seconds, and ten without the buzzer, to see if he can keep the rhythm unaided. The subject is blindfolded and tries to press a key in exact time with the swing of the pendulum that passes over a little cup of mercury, completing an electric circuit to the registering apparatus where a small needle makes a jagged nick in the line that is traced on the paper. The child's signals on the key also are shown in a dent on a line opposite, and

Measuring Subject's Quickness in Response to a Light, a Buzzer and a Tickler

the space between the two lines is filled with a wavy tracing from a third needle that makes fifty curves to each second. If a perfect record has been made, the pendulum dents and those of the key will be exactly opposite each other. Differences are easily counted by the wavy lines. This is considered one of the most important of all the tests, as keeping time is highly essential. Occasionally, the experiment enables the examiners to pick the instrument best suited to the child. An exceptionally good record at the rhythm test indicates that the drum is the piece the child should try to master, especially if other tests show indifferent records.

From this device, the pupil moves to another table where he taps an electrically charged steel plate with a metal pencil, each beat being registered on an electric counter connected in the same circuit. The examiner holds the stop watch on the candidate in this race, and at the end of half a minute, the counter dial will show how many times the pencil has touched the plate. A free arm and wrist movement with right and left arms is required. This experiment shows, the scientists say, how fast the brain can send out impulses and how rapidly the muscles can act. They believe that the same apparatus could be adapted to testing athletes, runners especially, by showing how fast they could move their legs. On this same instrument, the child's dexterity is tested. Just above the tapping plate are three holes, set in the form of a triangle. The object is to put the pencil into each one of the holes successively as many times as possible in half a minute. Contact of the point at the bottom of the hole moves the counter so that the score is easily computed by the examiner, who again calls time with his stop watch. A good showing at both of these tests is held to indicate a natural ability toward the violin or other string instrument.

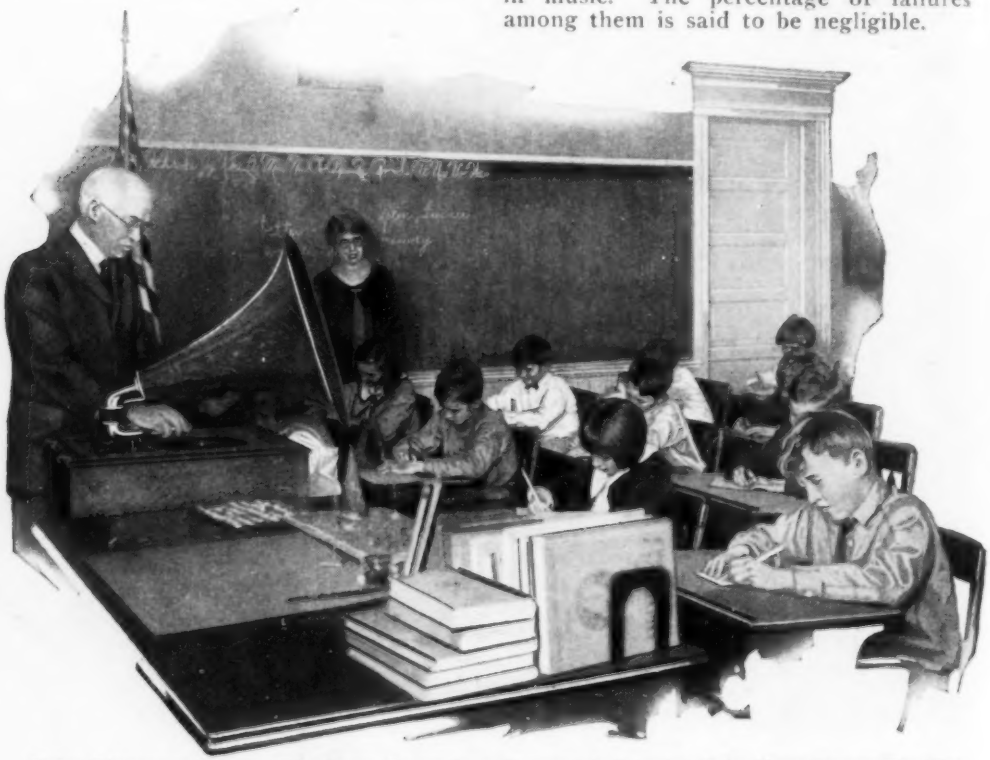
An ordinary wire and drill gauge has been adapted to a precision test that shows how steady the pupil's nerves are and how carefully he can perform a hand movement within a restricted space. The gauge is on a block of wood and is elec-



Keeping Time to Pendulum's Swing by Pressing Key Tests the Sense of Rhythm; Inset Shows Needles That Register the Beats and Errors in Fiftieths of a Second

trically connected to a buzzer. The child is given a steel-pointed pencil and told to insert the point in each of the holes on the gauge without touching the metal. If the pencil strikes the sides of the holes, the buzzer sounds and the test is over. Speed is forgotten for the time being, but the pupil is supposed to average about one hole a second. The larger openings are attempted first, progressing to the smaller ones where the chances for "going into the rough" are greatly increased. A score of eighteen or twenty holes is considered good.

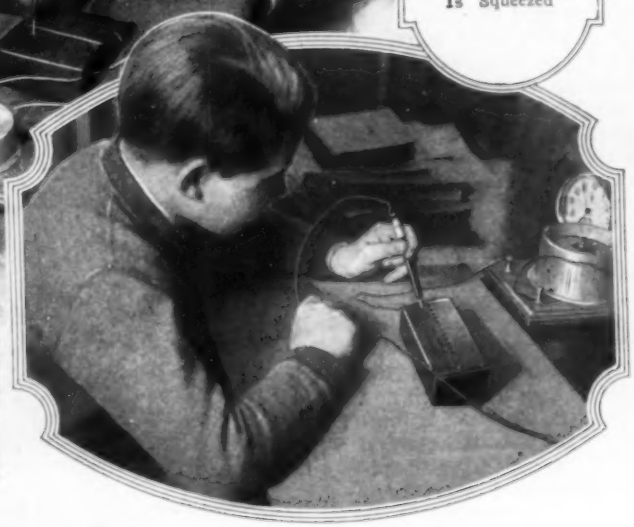
After these exacting tests, the pupil is given a three-second picture show. A slide is thrown upon a screen from a stereopticon which can be turned off and on by an electric switch held in the hand of the examiner who keeps track of the time with his stop watch. There are ten objects on the slide, numbers, figures or, perhaps, pictures of animals. The child is told to look intently at the screen and at the end of the three seconds, when the picture is snapped off, he must write down the names of all the objects he was able to identify and remember. This is the visual memory test, to gauge the candidate's probable ability at reading music. Many children fail to learn to play an instrument because they have trouble coordinating their fingers in response to the visual impulses they receive. If this is a weak point, it is likely to be revealed in the next test which is performed with a flat board in which are set differently shaped wooden blocks. These are removed and stacked in three piles. At the word "go," the child races against the stop watch, trying to fit the insets into their proper places. The world's record was made in five and three-fourths seconds by a young woman. Almost anyone can construct this apparatus, and time can be measured closely enough for ordinary purposes with a plain watch. A strength test of wrist, hand and fingers on a dynamometer, a grip with a spring in it that moves a pointer to a figure on a dial showing the amount of pressure exerted, completes the experiments. The results, which are graded on the basis of 100, are recorded for the guidance of teachers and parents. That the tests have practical value is indicated by the creditable records being made by those who have passed them and are taking further courses in music. The percentage of failures among them is said to be negligible.



Giving Elementary Tests to Schoolroom Groups from Phonograph Records; Only About Twenty-Five Per Cent of Pupils Get High Enough Marks to Warrant Taking the More Advanced Tests

Fitting Blocks into Insets Tests Ability to Co-Ordinate Movements

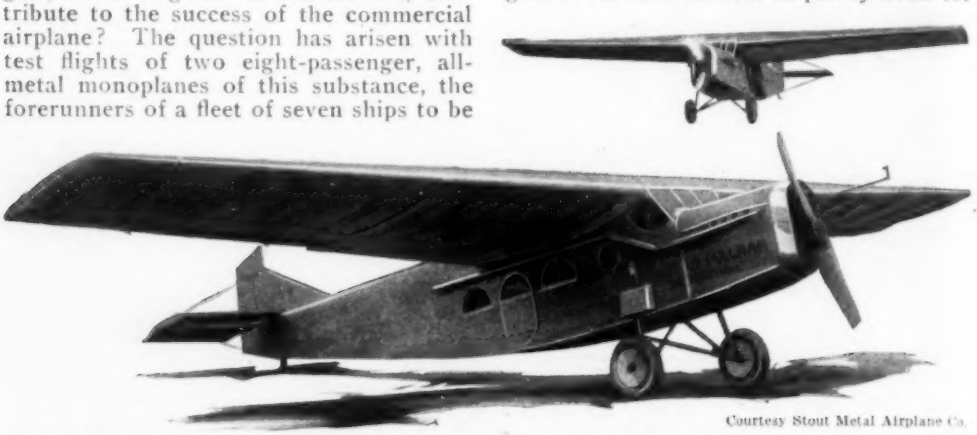
Strength of Grip and Fingers, Essential in Playing Some Instruments, Is Measured on This Dial When Handle Is Squeezed



Tapping Test Indicates Skill at Rapid Movement with Arm and Wrist; Right, the Dexterity Event, Trying to Put Pencil in Small Holes without Touching Metal

METAL "PULLMANS OF THE AIR" PROVIDE LUXURIES

What will the magic metal, duralumin, the lightweight alloy of which the dirigible "Los Angeles" is constructed, contribute to the success of the commercial airplane? The question has arisen with test flights of two eight-passenger, all-metal monoplanes of this substance, the forerunners of a fleet of seven ships to be used in regular hourly service between Chicago, Detroit and other cities. Each plane weighs less than the ordinary limousine motor car, and more than 1,000 pounds less than other similar types of aircraft with the same engine. They have a wing spread of fifty-eight feet, are forty-five feet long and have a 400-horsepower Liberty motor. The exterior surfaces of wing and fuselage are corrugated. One of the planes, on a trial flight, carried a load of 2,379 pounds, climbed the equivalent of a mile in twelve minutes and made 116 miles an hour on a straightaway course. The cabins have comfortably upholstered chairs and the two rear-seat pairs fold together to form benches on the side so that card games can be played if passengers tire of the scenery on long trips. Meals can be served on these improvised tables from a small galley in the rear. The engine is muffled to minimize noises, radio sending and receiving sets are carried, there is space for mail, and instruments in the cabin show how high and fast the plane is flying. Bulkheads between the passengers' and pilot's compartments protect the occupants from sound and vibration. For winter flying, openings to the main cabin from the engine room furnish heat in plenty even for zero weather, and in summer cooling is obtained through window ventilation. Baggage is carried in a wing compartment.



Courtesy Stout Metal Airplane Co.

Will Planes like This Dot Our Skies in the Commercial Flights of the Future? One of the All-Metal Ships for Airline between Detroit and Chicago

FIRE PUMP RUN BY AUTO WHEEL PROTECTS HOMES AND WOODS

In a few moments' time, the automobile may be converted into an effective fire engine by means of a portable pump that is operated by a belt around one of the rear wheels of the car. It is said to have a lifting capacity of twenty-four feet through a one and one-half inch suction hose, and to deliver a stream strong enough to combat a house or barn fire through 2,000 feet of hose. No

Testing Pump's Power at a Special Demonstration; This Is the Entire Outfit Including Feed Pipe and Spray Hose

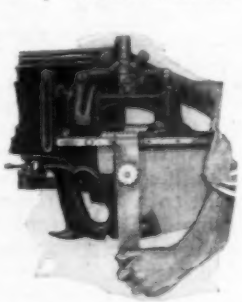
priming is necessary. The outfit is also useful for pumping out cellars and swamps, filling tanks, flushing sewers and many other purposes such as fighting forest fires and protecting small villages that do not possess larger equipment.

AUTOS AND ROADS WORTH AS MUCH AS RAILWAYS

That the motor transportation industry in the United States is now larger than the railroad business is indicated by reports from the federal bureau of public roads and the national automobile chamber of commerce. The value of the more than 17,000,000 motor vehicles and auto roads together is placed at about $15,000,000,000, practically as much as our railroads, while there are 450,000 miles of surfaced rural highways, nearly double the total railroad mileage. The motor-car industry employs 2,750,000 persons, about 1,000,000 more than the railroads. In 1923, motorists spent over $6,000,000,000, close to the gross revenue of the railways.

AUTOMATIC SAW FILER IS RUN BY HAND OR MOTOR

Saws are sharpened quickly and accurately in an automatic filer that can be operated by hand or by motor and requires little skill. The saw is clamped securely in a holder and each tooth is given an exact edge by a swinging file fixed to a carriage that advances automatically. An even job is the result and the saw can be set correctly or new teeth filed much more easily than in the ordinary way.



When It's Noon in Baltimore, What Time Is It in London? On Bright Days, This Many-Sided Sundial Will Tell.

SUNDIAL WITH SEVERAL FACES TELLS WORLD TIME

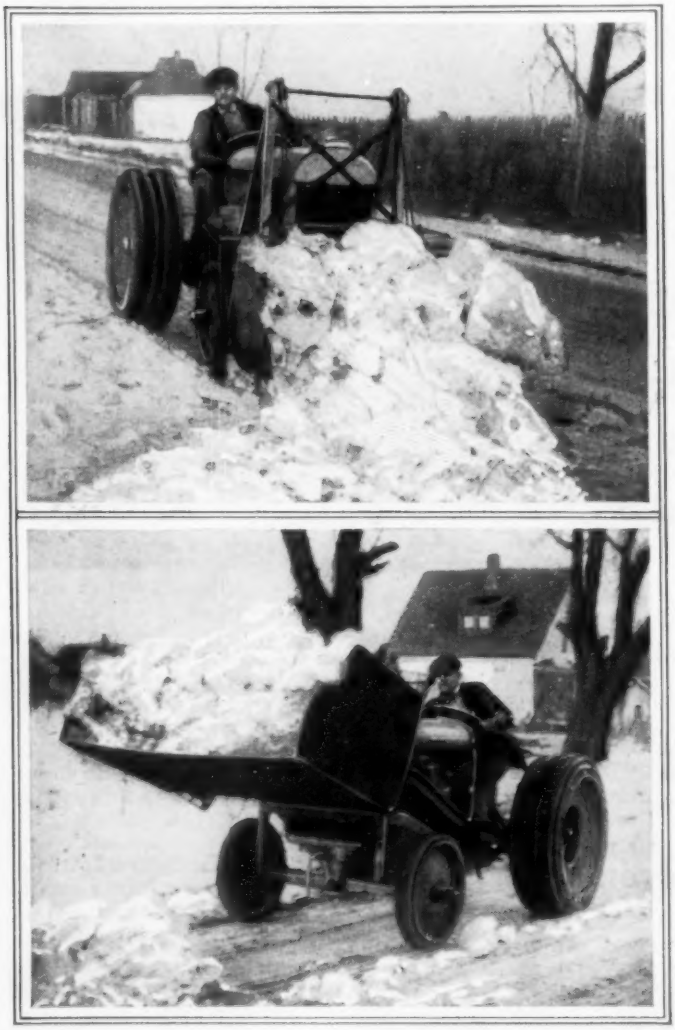
A unique sundial in Baltimore, Md., has several faces set at different angles, so that the indicators register the time for the principal cities of the world. Each unit has been carefully adjusted to afford the greatest possible accuracy and besides the time, the latitude and longitude for each locality are engraved on the dials.

WHAT CAUSES HOLES IN CHEESE MYSTERY IS SOLVED

Experimenters in the department of agriculture are reported to have discovered that special curing processes and preparation of the curd, cause the holes in Swiss cheese. The product is now being supplied to employes at a cost of about twenty cents a pound for materials. The expense of the experiments, which were started nearly ten years ago, is being recovered by the sale of the cheese. The demand for it is so great that orders are rotated according to a system which permits all employes to make purchases.

TRACTOR FOR SCOOPING SNOW DIGS AND LOADS DIRT

Snow is removed at a saving of time and cost with a tractor outfit that scrapes the street, hoists the load and carries it away in almost one continuous operation. The same apparatus is suited to moving dirt in back-filling and similar operations, such as digging ditches, and a crane attachment may be used in place of the scoop to lift loads up to 2,500 pounds. No counterbalancing is necessary since the weight is evenly distributed between the front axle and the pivot pins located near the rear.



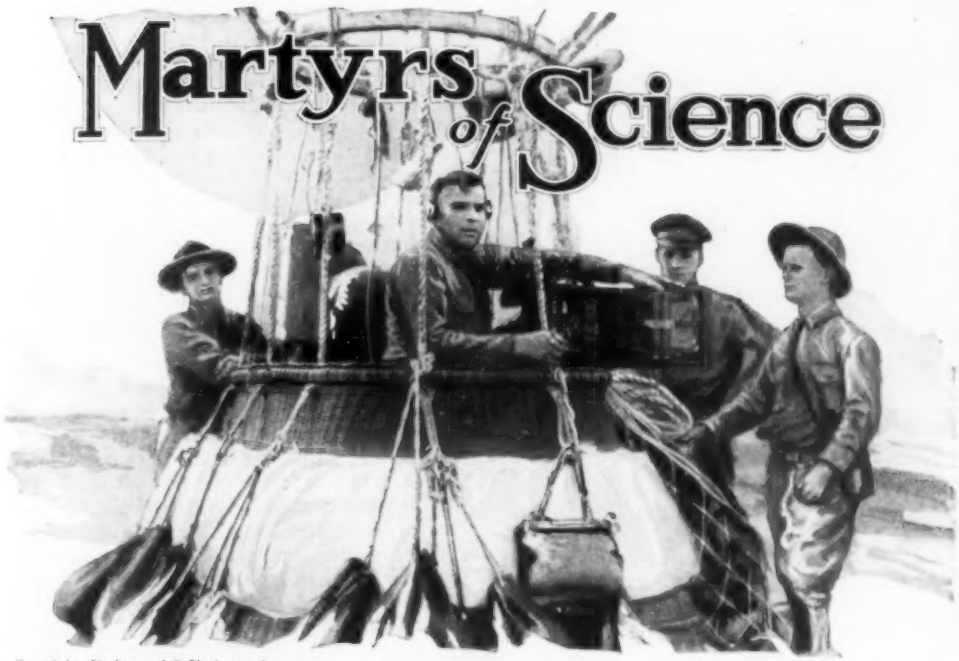
This Tractor Scoop, Originally Designed for Removing Snow, Has Been Found Equally Efficient as a Scraper and Back Filler

ELEPHANTS HELP HUNT BIRDS FOR MUSEUM SPECIMENS

Capture of two specimens of the nearly extinct pink-headed duck for the museum of natural history in New York, illustrates how difficult it is to catch such rare birds as these and how skillful many of the species are in evading the hunters. Elephants are needed in pursuing this particular duck, as it haunts the thickly overgrown swamps of upper Bengal where a man on foot cannot travel. It was one of the objectives of the Vernay-Faunthorpe expedition into India, but the members did not get sight of the bird after prolonged search. The specimens were finally caught by a native hunter. Another rare and shy bird is the helmeted hornbill. Scientists say that trained monkeys would be needed to catch it, as it lives in high forests, eats fruit and does not descend to the ground. One might almost believe it realizes that it baffles the hunters, for pursuers have heard it utter a series of derisive whoops, followed by a loud cackling laugh. This strange bird gets its name from its heavy bill surmounted by a high helmet-shaped top, the front portion of which is solid bone. Various species of pheasants are becoming extremely rare. One of the most elusive is a variety found in Annam which has eyelike spots on its feathers like a peacock. It was finally identified from four detached feathers sent to a Paris museum. The bird itself remained a mystery for several years, but a live specimen was finally captured in Indo China.

¶At the Hawaiian volcano observatory, an average of seven or eight earthquakes are recorded weekly.

Martyrs of Science



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Lieut. John Choptaw Receiving His Wireless Set in the Basket of His Balloon Just before Start of Fatal Flight in Which Lightning Struck the Big Gas Bag

Scores of Lives Deliberately Risked and Sacrificed in Pursuit of Knowledge to Protect Others from Disease and Death

A FEW lines tucked away in odd corners of the daily papers recently announced that Dr. Kohler, of Berlin, internationally known for his X-ray research work, had submitted to amputation of his right arm in an effort to stay the progress of deadly burns from the mysterious rays. A few days earlier, the papers reported the amputation of a French scientist's hand for the same reason, and in the same month an American experimenter suffered a similar loss.

Only a few weeks before the papers announced that Prof. J. Bergonie, a famous French savant, had succumbed to radium burns after his right arm and three fingers of his left hand had been amputated to stay the strange malady. The next day the chemist Demenitroux, of Paris, who worked with the late professor and Madame Curie in discovering radium, died.

Just a few more martyrs to the cause of science, the tragic fate of the five, all coming within a space of less than four months, has focused attention anew on the men who give their lives in research work, and the untold hosts who take the same risks, but escape the consequences.

The same week that Prof. Bergonie and Demenitroux died an American, Dr. W. J. Baerg, of the University of Arkansas, returned from the Panama canal, where he had gone just to let the most deadly centipedes, scorpions and tarantulas of the tropics bite him, so that he could observe if the effects of their poison were fatal to man. He returned safely.

Records of American colleges, the public health service and the Rockefeller Foundation investigations are full of similar sacrifices, some fatal and some, as in Dr. Baerg's case, not. When Dr. Walter Reed made his great discovery that the mosquito carried the yellow-fever germ, and called for volunteers from the American troops in Cuba to prove it, enlisted men crowded forward to be inoculated, but, he recorded, when he explained that he would see that some adequate compensation was forthcoming for them, they all drew back and declined to submit to the experiment if they were to receive any money gain from it. That is the spirit which marks all the martyrs of science.

Dr. Jesse Lazear, one of the army-commission doctors in Cuba, lost his life in

Dr. W. W. Miller, U. S. Public Health Service, Who Lost Life While Fighting Typhoid in Washington

the yellow-fever studies there. Gen. Gorgas, who shares the honors in conquering the disease, escaped and made the Panama canal possible by wiping out the fever there, but his escape was due to the fact that he had had the fever years before in Texas, recovered, and hence became immune.

Within recent years Dr. Howard B. Cross, a young physician of the Rockefeller Foundation, went to Mexico to examine suspected yellow-fever cases at Tuztepec, contracted the disease, and died. The Mexican government named the public-health laboratory at Vera Cruz in his memory. Dr. Clarence Meisinger, a brilliant young scientist of the weather bureau, lost his life last fall when an army balloon in which he was studying thunderstorms was struck by lightning and burned. Like Dr. Cross he was a young man, with a brilliant future, and married, but he gave up his desk in Washington to go out and study the storms in the upper atmosphere.

To be caught in a thunderstorm in a balloon filled with inflammable hydrogen gas is a terrible experience, yet with Lieut. James T. Neeley, an army balloonist, Dr. Meisinger deliberately sought out storms and went up in them to complete studies for a report on their effect on air pressures. They had virtually completed the work, but decided to make one more trip, their tenth. The charred bodies and wreckage of the balloon were found on an Illinois farm the next day.

Announcement recently that four lepers had been cured and discharged at the national leprosarium at Carville, La., after treatment with chaulmoogra oil recalled the story of Dr. Joseph F. Rock, leader of the expedition which found the Taraktogenos Kurzii tree and brought back its seeds to civilization to grow trees from which the healing oil is extracted. He spent nearly a year wandering in the jungles of South China, Siam and upper Burma before he eventually found the trees. On that expedition the plant hunters braved crocodiles, tigers and wild elephants as well as the jungle fevers. Going up the tortuous Meh Ping river to Raheng to reach the overland route to Moulmein, he relates an experience aboard his boat:

"The river at this season being low, it was difficult to make a landing. We tarried only long enough to dispose of many bags of rice, the cause of our constantly grounding on sand banks. Once I lost patience and, being in negligee, I jumped overboard and swam ahead of the boat, expecting it to follow soon. Anxious calls from the captain urged me to return to the boat, quite a difficult matter against the current. The waters, I learned afterward, are infested with crocodiles.

"When I called on the governor of Mesawt, he was holding court for the trial of elephant thieves, who carry on a prosperous business near the border. Leaving his chained prisoners sitting on the floor, the magistrate accompanied me to the rest house where Siamese officials stop when en route from Raheng.

Dr. T. F. Richardson, U. S. Public Health Service, Another Typhoid Victim Who Lost Life at New Orleans

Dr. Howard B. Cross, of Rockefeller Foundation
C. Le Roy Meisinger, Killed in Balloon
Dr. L. W. Jenkins, Public Health Service, Drowned at Sea
Dr. Joseph F. Rock, Who Found Plant to Cure Leprosy
Dr. Frederick H. Baetjer, Who Has Lost Eight Fingers to X-Ray
Dr. T. B. McClintic, Public Health Victim of Spotted Fever

Dr. Rock's Photograph Copyright, Harris & Ewing

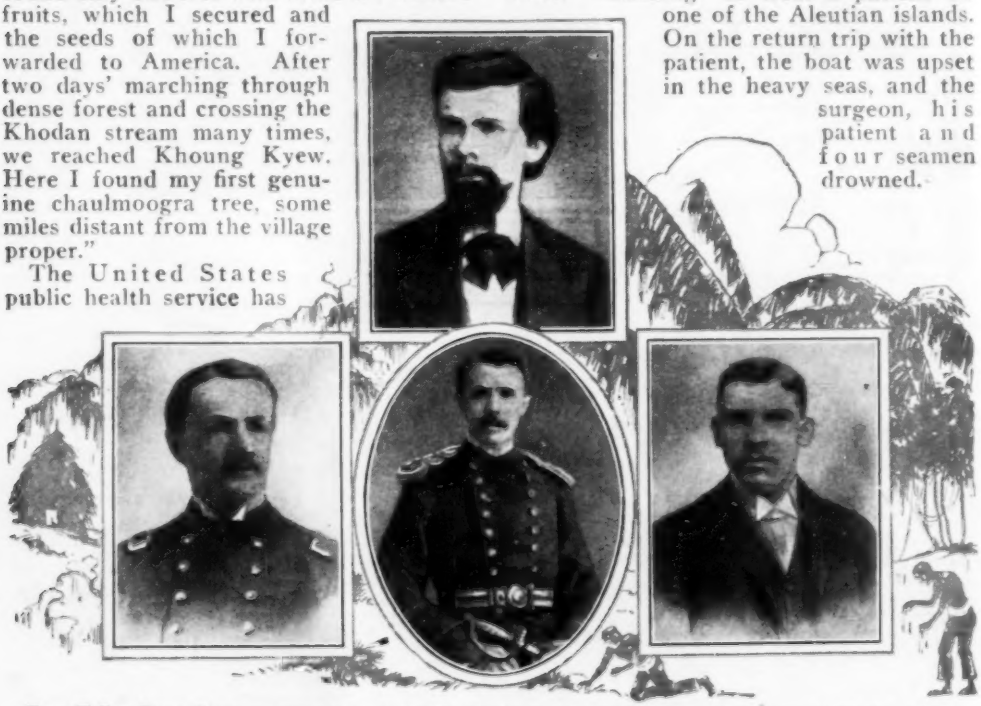
"Our path lay across the Kawkereik hills, which are covered with glorious verdure, and it was in this region that I first encountered Taraktogenos Kurzii. Unfortunately, it was not in fruit. I was informed by a Burmese village quack that July is the month in which the chaulmoogra fruits ripen. We hurried on and finally reached decadent but beautiful Moulmein on Christmas Eve.

"My next point of venture was the Kalama range of the Martaban hills, where the natives said kalaw, or chaulmoogra tree, could be found. The mountains rise abruptly from the plain, are strewn with huge bowlders, and are intersected by numerous rocky creeks on whose banks grows a species of Hydnocarpus, called by the natives kalaw, but it was not the long-sought-for object of my search.

"I made a last trip into the hills of Oktada and found that Mr. Shwaloo, my interpreter, was correct as to the presence of tigers, for there were fresh tracks leading not far from our camp to the top of the ridge. Only a few hours before the big cat had stalked over the sandy trail to his haunts in the dense, low bamboo forest, which we had to penetrate in a bent position in order to reach the kalaw trees. In all our rambles for three days we found only one tree with some 170 mature fruits, which I secured and the seeds of which I forwarded to America. After two days' marching through dense forest and crossing the Khodan stream many times, we reached Khoung Kyew. Here I found my first genuine chaulmoogra tree, some miles distant from the village proper."

The United States public health service has quite a long list of martyrs. Assistant Surgeon Rosewell Waldo, one of the first of them, gave his life, as far back as 1878, in fighting a yellow-fever outbreak. Two years later Assistant Surgeon W. C. W. Glazier died at Key West from the same disease, contracted while fighting an epidemic there. In 1891, Assistant Surgeon John Frederick Groenevelt was the third yellow-fever victim, dying while fighting the epidemic on the Gulf of Mexico. Another two years, and the same fever added a fourth name to the honor roll, that of Assistant Surgeon John W. Branham. Another died at Key West in 1899, Dr. William Ralph McAdam, and the deadly fever took an additional victim when William W. Rightman contracted it while fighting an epidemic in Ecuador, for which foreign service he had volunteered.

Typhoid cost the lives of Assistant Surgeons Thomas F. Richardson and W. W. Miller, both catching the disease while studying epidemics of it. In 1912, Dr. Thomas B. McClintic, of the health service, fell a victim to Rocky Mountain spotted fever, while studying an epidemic in the west. One of the most recent of government martyrs on the list, Assistant Surgeon Luther W. Jenkins, was drowned at sea when he went from the coast-guard cutter "Manning" to treat a patient on one of the Aleutian islands. On the return trip with the patient, the boat was upset in the heavy seas, and the surgeon, his patient and four seamen drowned.



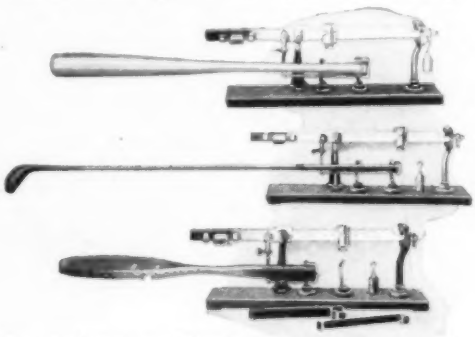
Four Yellow-Fever Martyrs from the U. S. Public Health Service Honor Rolls, Dr. Rosewell Waldo, Above, and Drs. John F. Groenevelt, William R. McAdam and John W. Branham

RADIO IS AID TO GOVERNMENT IN ECONOMY CAMPAIGN

It is estimated that the government is saving approximately $100,000 a year in communication charges by handling its messages by radio. Coastwise and off-shore business is transacted by the navy and inland dispatches for many departments by the army, with what signal corps officers call "the most complete and perfected radio network in the world." The war department's message center is in the munitions building in Washington. Twelve stations link the various corps areas, and within each of these divisions are substations, making sixty in all. There are twenty-one in Alaska and seventeen distributed through the island possessions and Panama. Army transports also have radio and at Fort Leavenworth and Salt Lake City are 10-kilowatt tube transmitters to relay transcontinental messages. Leased telegraph wires are maintained from Washington to New York and Baltimore.

SCALES FOR CLUBS AND RACKETS SHOW LEVERAGE WEIGHT

Baseball bats, tennis rackets, golf clubs, and other sports paraphernalia, are given the proper heft or balance with the aid of delicate scales devised for the use of manufacturers, especially. They show the leverage that the weight of a club exerts when held in a horizontal position by the grip. The article is placed under brackets on the base of the scale with the main part extending so that the weight presses upward on the bracket and registers the amount on the beam. Exact duplication of implements from a tested sample is possible with these scales.



Bat, Golf Club and Tennis Racket Adjusted in Scales to Show the Leverage at the Handles

MOVIES FOR AIRPLANE TOURISTS ADD VARIETY TO JOURNEY

Passengers on an English airplane were treated to a motion-picture show lasting an hour and a half while cruising over London. The screen was placed at the forward end of the car and the projector at the rear. Non-inflammable film was used as a precaution against fire. The success of the innovation has led to plans for making regular use of the "flying movies" on long trips and when fogs obscure the scenery.

Airplane Passengers Enjoying a Picture Show in Their Cabin during Journey; Fireproof Film Was Used for Added Safety

YEARLY GOLD TOTAL FOR ARTS EIGHTY MILLION DOLLARS

Approximately $80,000,000 worth of gold is used annually in the manufacture of jewelry, gilding, fillings for teeth and in similar work in the fine and liberal arts. Strict account is kept of all this material, and only highly skilled artisans are allowed to handle it. In some shops, the washroom drains are so adjusted that gold dust from the workers' hands can be reclaimed, saving thousands of dollars a year.

Clerks Examining Bullet-Ridden Bandit Dummy

CLERKS TAUGHT TO GUARD BANK BY SHOTS AT DUMMY BANDIT

The prevalence of holdups has led bankers in southern Illinois to use a dummy bandit as a target for their clerks during pistol practice to train them to repulse attacks from real robbers. The figure is life-size, and the results of each marksman's shots are noted by writing his name at the holes made by his bullets.

FEW ANIMALS LEFT THAT DEFY SKILL OF TRAINERS

Only a few species of wild animals remain untamable in spite of the fact that, a short time ago, many now represented by specimens in captivity were thought to defy any attempt at training. The fierce African elephant, classed among the most ferocious living creatures, is hunted for use as a beast of burden, and the shy and once unconquerable zebra, until recently said to resist every effort to break it to harness, has been taught in many cases to trot docilely in teams, hitched to carts and buggies. Even the most savage wolves submit to the skill of patient trainers, and if caught while young, can be raised to be as domestic as a dog. Most wildcats never lose their dislike for captivity, and rarely overlook an opportunity to attack their keepers. Though captured as kittens the ferocity of this wild feline remains throughout its life. Another wolflike animal, known as the "Tasmanian devil," is so wild and savage, that it refuses to respond to any treatment, and usually dies if kept caged. All the great species of the cat family, such as lions, tigers, and some leopards seem to take kindly to training, but the black jaguar, one of the most dangerous of beasts, cannot be domesticated. If caught in the kitten stage, it spitefully refuses the attentions of mankind. Generally, ordinary leopards are captured young, when they can be fairly well trained, but like the North American bobcat are liable to revert suddenly to savagery.

NEWSPAPER RACK FOR WALLS SAVES COUNTER SPACE

Newspapers are held in a vertical position where patrons can quickly make their selection, in a rack that fits against the wall, saving valuable counter space at public stands. Weights, with wire-bracket extensions to keep the contents from falling out, are attached to the divisions in the rack, and there is a slot in the bottom rest for easy withdrawal. Papers are inserted with little trouble, are protected from damage and can be arranged in attractive displays on this holder.

Rack Installed on Wall, Showing How Paper Is Easily Slipped Out for Sale

New Radio Tube Works from Light Socket

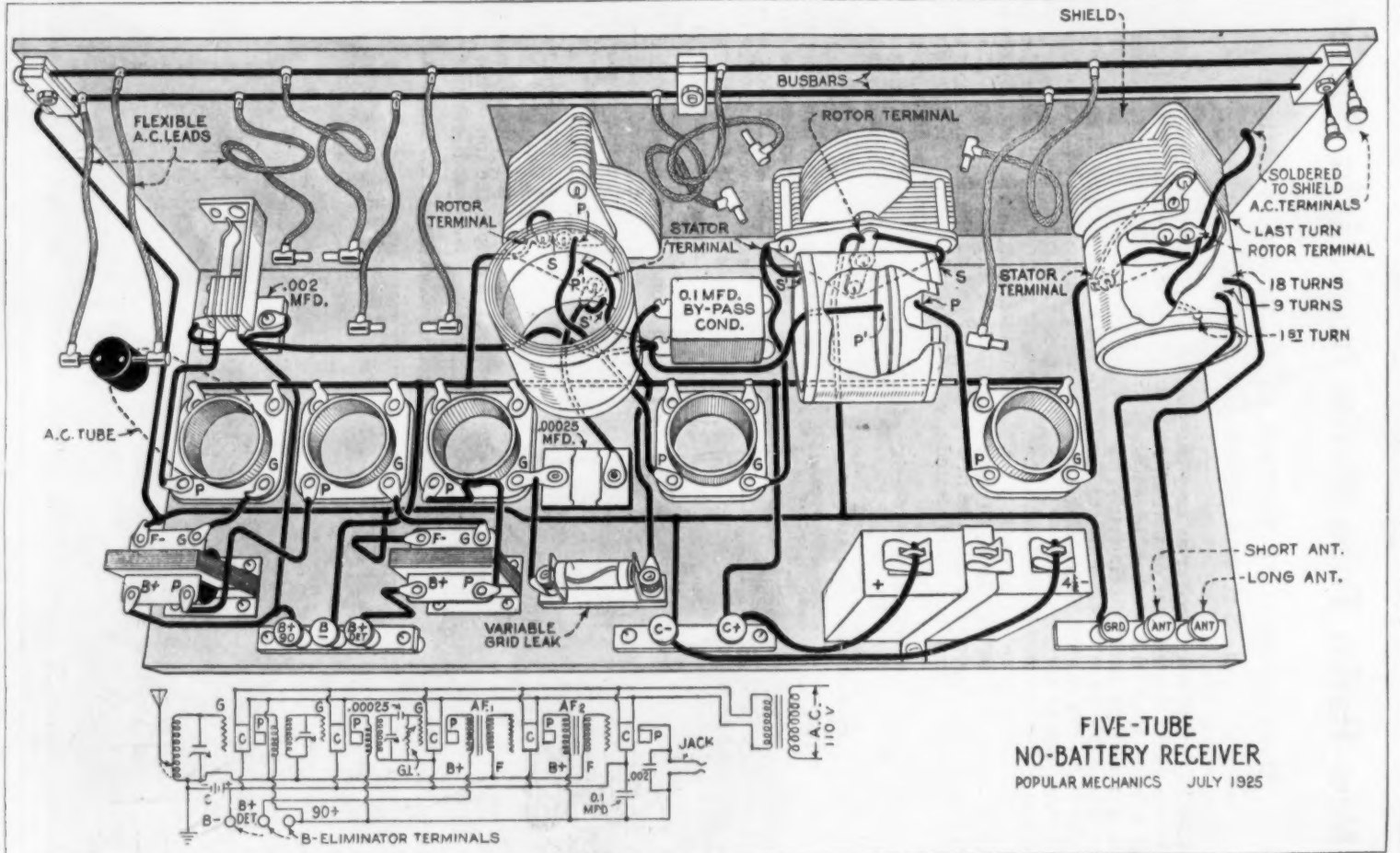
Uses Alternating Current to Eliminate A-Battery in Set and Gives Greater Volume

MAKING the radio receiver as easy to use as an electric iron or toaster, a new tube now on the market dispenses with the storage battery completely, as the "filament" leads need only to be plugged into the nearest alternating current electric-light socket.

When a B-eliminator is used with the set it becomes practically a no-battery set, as the ordinary C-battery lasts so long that it is rarely considered at all. The new tubes, which have been successfully tested in Popular Mechanics laboratory, use the standard type of grid and plate, but there is no filament. Replacing the latter is a hollow porcelain tube, in the center of which is a heater element, supplied from the light plug. Around the outside of the tube is a metal sheath or cylinder, known as a cathode, and when the current is turned on this is heated by the element inside the porcelain and gives off electrons just as the filament does in the common battery tube. The 110-volt current from the lighting circuit is stepped down through a small transformer, which is provided with taps for various voltages from three and one-half to five. When using from one to three tubes, the 4-volt tap is used and for four or five tubes the 5-volt tap. The tube base is made to fit any standard socket, but only one of the filament prongs is used—the one normally used for the negative filament lead—and this is connected, in the tube, to the lower part of the cathode.

The current is supplied to the cathodes of the tubes by means of two busbars running across the top of the panel, and connection is

Drawing of New Tube, and Set in Which Both A and B-Batteries Are Eliminated



FIVE-TUBE NO-BATTERY RECEIVER

POPULAR MECHANICS JULY 1925

made to the tubes by flexible leads with small clips on the ends that fit over the cathode prongs on the tops of the tubes. There is no need for rheostats in the set using these tubes, another feature that should appeal to the home radio builder.

Elements That Make No-Battery Set Possible; from Left to Right, the B-Eliminator, the Tube and the Step-Down Transformer

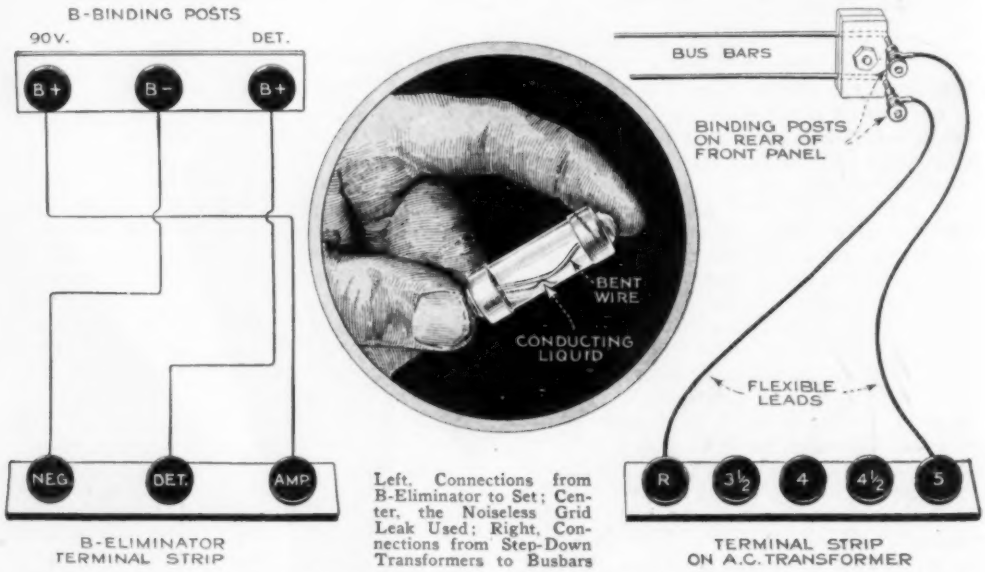
The five-tube set described in this article can be built for a cost of about $105, including a $25 B-eliminator. In an actual test the volume of this set was about twice that of ordinary tubes. The tone quality was maintained even in the exceptionally loud signals. Seventeen distant stations were brought in under unfavorable conditions in less than two hours. All parts used are standard, and the circuit is probably familiar to many of our readers. The schematic diagram below the large detailed drawing is given for checking purposes and to clearly show the basic changes made in the usual circuit, to apply the new tubes to any standard receiver. The front panel can be either bakelite, formica, or any similar material, 3/16 by 7 by 24 in. This is a size that will fit the standard cabinets. Where a cabinet can be obtained to take a panel 3/16 by 8 by 25 in. more room is available for placing the a.c. busbars. The wood base panel is ½ by 7½ by 23½ in. A thin brass shield 3½ by 15½ in. is used on the rear of the front panel for shielding the tuner unit and the two tuned radio-frequency units. The position of this shield is clearly shown in the simplified diagram. The shield must be cut away from the instrument mounting holes so that no instrument touches the shield. This shield is grounded to the negative C-battery and ground line; this ground wire is not shown on the diagram. The busbars should be of heavy wire, not smaller than No. 12 and heavier if possible. The busbars are fastened to the panel as far from the set wiring as possible, to prevent any a.c. hum by induction. Three sets of bakelite blocks, made from strips 3/16 by ½ by 1¼ in. long are used as clamps, and are notched to take the busbars, separating the bars as far as possible. A nickel-plated machine screw holds the blocks together in the center, and completes the mounting through the front panel. The tuner coil and two radio-frequency units are mounted with the coils at right angles,

low enough on the front panel to clear the flexible leads to the tubes. These units can be any standard kit type, or made up in the low-loss form if desired. The condensers used are .00035 mfd. The tuner coil consists of 80 turns of No. 22 d.c.c. magnet wire wound on a 3-in. bakelite tube, 3 in. in diameter. This coil is tapped at the 9th and 18th turns for short and long aerials. Use the aerial connection that best spreads the stations out over the dials. The tuner coil is mounted on the condenser by means of two small brass brackets. If the variable condensers supplied with the radio-frequency units are .0005 mfd. use the same type of condenser with the tuner coil, and place 58 turns on the coil, instead of 80. Tap off at 9 and 18 turns as before.

The grid leak used is a new form of the variable type, and is very efficient. The range is from ½ to 7 megohms. Any good make of audio-frequency transformers, with a ratio of 3½ to 1 can be used. The jack is the open-circuit type. The binding post strips at the rear of the base panel are mounted on 1-in. fiber rods, or fiber tubing, by means of long wood screws. These bakelite strips supporting the binding posts are 3/16 by ½ by 3¼ in. long. Binding posts with engraved tops are used. It will be noted that the rotor plates of the radio-frequency unit condenser next to the tuner unit are connected to the ground line, and the rotor plates of the tuner unit condenser have a ground connection through the brass shield. No. 14 tinned copper wire is used for the circuit, and covered with spaghetti tubing where necessary.

The receiver is tuned in much the same manner as a neutrodyne set, the dial readings for the various stations being about the same for a given wave length. The connections from the B-battery eliminator and the a.c. transformer are clearly shown in the sketch. The two plugs can be connected in the same socket by means of a double-socket arrangement. Test the circuit for error by connecting one side of the a.c. lead to the set on the 3½-volt terminal on the a.c. transformer, and place only one tube in the socket. If the heating element in the tube glows properly change the wire to the 5-volt post on the transformer and place the other tubes in the sockets. Plug in the horn. If a drumming noise is heard in the horn reverse the polarity in the plug leading to the B-battery eliminator. If a bluish tinge is noticed in any of the tubes, it soon passes away, but if the heavy blue color persists, and the tube does not function properly, it can be returned for replacement.

The cost of operation of this set is about 2/10 cent per hour. In some cases it may be found advisable to use a higher C-voltage, especially where a higher B-voltage than 90 is used, and in many cases it will be found that the ground already present in the a.c. line is sufficient, and that the set will work better without a ground.



Left, Connections from B-Eliminator to Set; Center, the Noiseless Grid Leak Used; Right, Connections from Step-Down Transformers to Busbars

Complete blueprints and material list for the construction of this receiver may be obtained for the cost of packing and mailing. Send 10 cents to the Radio Dept., Room 515, 200 E. Ontario St., Chicago, specifying this set.

THREE-JOINT CONNECTING ROD STOPS AIRPLANE POWER LOSS

What scientists herald as an exceedingly important aid to aviation is a simple engine attachment, devised by a French inventor to prevent loss of motor power when planes ascend to great altitudes. Tests by the French air service are said to have confirmed the claims of the maker, and with its use, heights of six miles without great decrease in engine force and transatlantic flights in a few hours between New York and Paris are considered possibilities. Its secret is the introduction of an eccentric between the piston of the engine and the connecting rod, thus giving the part three joints instead of the two now used. This eccentric serves as a sort of knee, enabling the aviator to change the internal compression at will. A shift one way increases the size of the chamber, thus reducing the compression; a shift the other way makes the chamber smaller, increasing the compression and offsetting the growing rarity of the atmosphere as the altitude increases. At a height of three and one-half miles, a plane is said to lose fifty per cent of its motive power, a serious handicap to maneuvers and fast flights. The attachment weighs but sixteen pounds for a motor of 250 horsepower and is simple to operate.

SHARPENER FOR LAWN MOWER HAS RENEWABLE STONE

Lawn-mower blades and the stationary knife at the bottom can be sharpened thoroughly and with little trouble with a whetstone inside an adjustable clasp that can be fitted to almost any make or size of machine and simplifies the operation. The holder has guide flanges that rest upon the edges of the blades and a thumbscrew for tightening it to the work. The sharpener is moved back and forth with a sweeping motion and a few strokes are said to be sufficient to produce a keen cutting edge. When the stone becomes worn, it is easily turned around, or may be taken out for cleaning with gasoline or soap and water when it gets coated with steel. The stationary knife of the mower is sharpened by removing it and placing it in a vise.

SPARE-TIRE RACK WITH SPRING SAVES LIFTING ON AND OFF

Spare tires are locked securely and do not have to be lifted on or off in a rack

Fitting Spare Tires into Rack That Has Spring to Lift It into Place

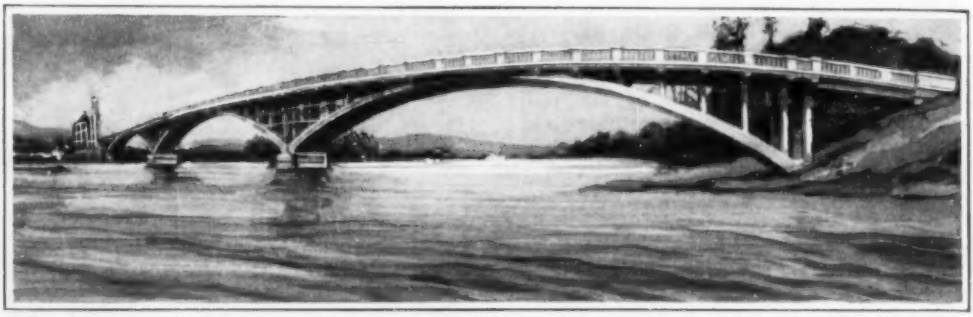
which has a spring within a steel tube that forms the back of the holder. This acts as an elevator, raising the tire to the curved upper part where it is fastened. To remove the spare, the lock is opened, a button touched and the tire pressed down. As it rolls out, the spring remains extended and ready to hoist the next tire.

SAND BLAST REMOVES VARNISH FOR INTERIOR DECORATING

Sand-blasting, the effective method for removing soot and dirt from the outside of buildings, has been adapted to interior decorating. Using an ordinary air compressor and blast equipment, five men in two weeks removed the varnish from 18,000 square feet of oak, cleaning it so thoroughly that the natural color and texture of the wood were revealed, and a light coating of filler was the only application needed to give an attractive finish. Eight men previously had worked a week with scrapers, sandpaper and varnish remover, but had cleaned only two sides of the beams on the ceiling.

THREE-SPAN CONCRETE BRIDGE SEVEN HUNDRED FEET LONG

Modern skill in concrete construction is exemplified in a handsome bridge over the Van Duzen river in Humboldt county, California, built to replace an old one which had become inadequate for automobile traffic. It has three long spans with a total length of 734 feet, the rising bridge forming a gracefully bowed arch from bank to bank. A concrete railing of artistic design, interrupted by drainage openings at the bottom, surmounts it. During the building, a temporary wooden roadway was laid across piles driven close to the surface of the water to handle the traffic.



Concrete Bridge, 734 Feet Long, over the Van Duzen River in California Nearly Completed; the Arching Spans with Upright Braces Are Sturdily Built to Withstand Time and Heavy Traffic

SCIENCE TO IMPROVE LEATHER AND MAKE BETTER SHOES

Processes by which shoes can be made more comfortable and millions of dollars saved to industry by prolonging the life of leather, have been discovered, according to the American chemical society. One involves using Glauber salts instead of the common salt in tanning hides. The presence of calcium chloride in the latter is said to be destructive, whereas the substitute is reported to have a definite preservative action. An apparatus has been invented for determining what kinds of leather allow the greatest amount of perspiration to pass from the foot and thus increase the wearer's comfort. It was found that patent varieties permit the least evaporation and ordinary calf leather the greatest. Science's warfare against bacteria of all kinds is also being used to the improvement of leather in showing how to kill various small organisms that cause spots, stains and other imperfections and in combating the effects of mold, which does its greatest damage after tanning.

ANTI-AIRCRAFT MACHINE GUN SHOOTS THREE MILES HIGH

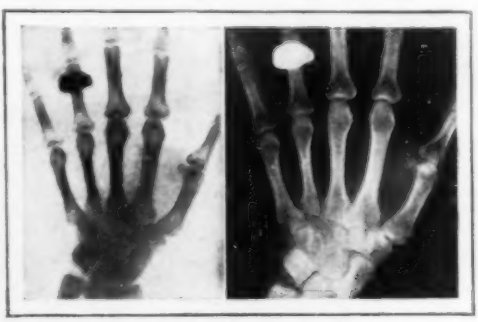
One of the most effective anti-aircraft machine guns that the war department has devised is a .50-caliber weapon with improved mounting and sights. It has an armor-piercing vertical range of from 6,000 to 7,000 yards and can shoot between 500 and 600 shots a min-

Testing the Late Type of Anti-Aircraft Gun for Army Defense; It Is Easily Moved and Has Long Range

ute. It also fires tracing shells for a distance of 2,200 yards. These bullets leave a path of smoke, visible by day or night, so that the effect of the fire may be seen and the aim corrected. The .50-caliber gun is to be made the standard for batteries. Other developments in arms for fighting airships include semi-automatic infantry shoulder rifles, improved mounts, sights, ball and tracer ammunition for .30-caliber machine guns. Greater efficiency is expected from the latest weapons, details of which are guarded as secrets.

X-RAY PICTURES BY TELEPHONE

Transmission of X-ray pictures over long distances by telephone has been successfully accomplished. In a test, one such photograph was sent from New York to Chicago in seven minutes without the loss of any detail, making an accurate study of the film possible. By this method and with the proper equipment for sending the pictures, the aid of eminent specialists and experts may be instantly summoned to assist in treatment of injuries and diseases in cases many thousands of miles distant, eliminating the necessity of moving patients to large cities for diagnosis of ailments requiring special study. The possibility of sending X-ray negatives by wire also permits physicians in small communities to procure the assistance of highly experienced doctors on the staffs of the country's large hospitals, in a short time, where a saving of hours or days may decide the success or failure of treatment. Persons meeting with accident or becoming ill while traveling far from home, could have the aid of the family doctor without the physician leaving his office.



X-Ray Photographs of Human Hand Transmitted by Telephone Nearly 1,000 Miles in Seven Minutes

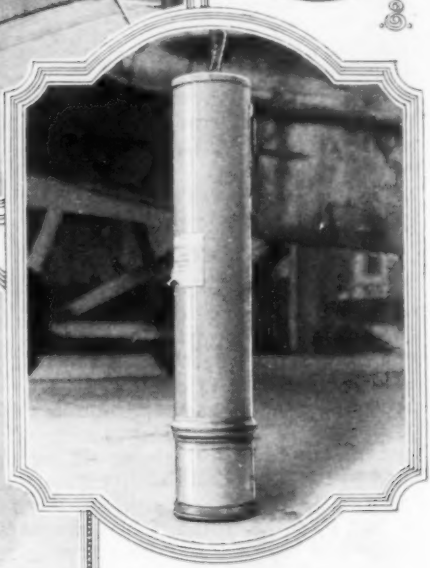
Picnic Luncheon Is Eaten in Comfort, without Leaving the Car, on Folding Table That Is Quickly Set Up and Fits under Cushion

FOLDING TABLE FITS AUTO DOOR FOR MEALS OR GAMES

Added comfort and utility can be enjoyed on outings in the motor car by using an enameled-steel folding table for luncheons or other purposes. On closed cars, it hooks between the glass and the inside edge of the door. It is supported by hinged braces that rest below the pane and are held by a cross wire. It can be set up in little time, and when not in use, is carried under the cushions or the door pocket. It is suitable for playing games, writing, or holds the radio cabinet or the typewriter. Seventeen inches long, fifteen inches wide and half an inch thick, it provides ample space for serving the picnic meal inside the car, doing away with the bother and possible unpleasantness of eating at an undesirable outdoor spot. The tables are so small that three or more of them may be carried in one car.

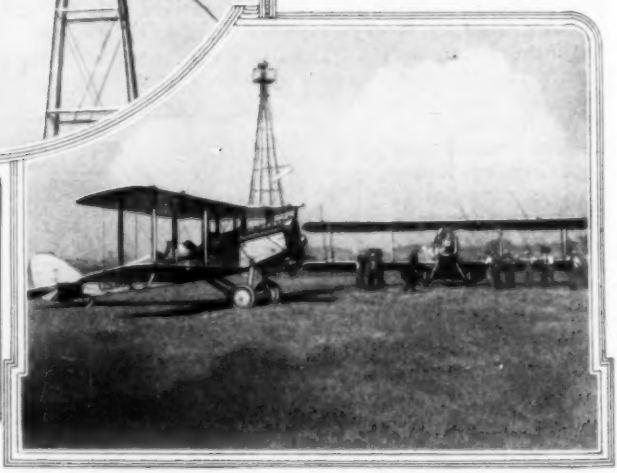
On the Blazing Trail of the Air Mail

Stopping for Fuel at One of the Emergency Landing Fields Which Are Set Twenty-Five Miles Apart and Have Facilities for Warming Oil and Water in Cold Weather

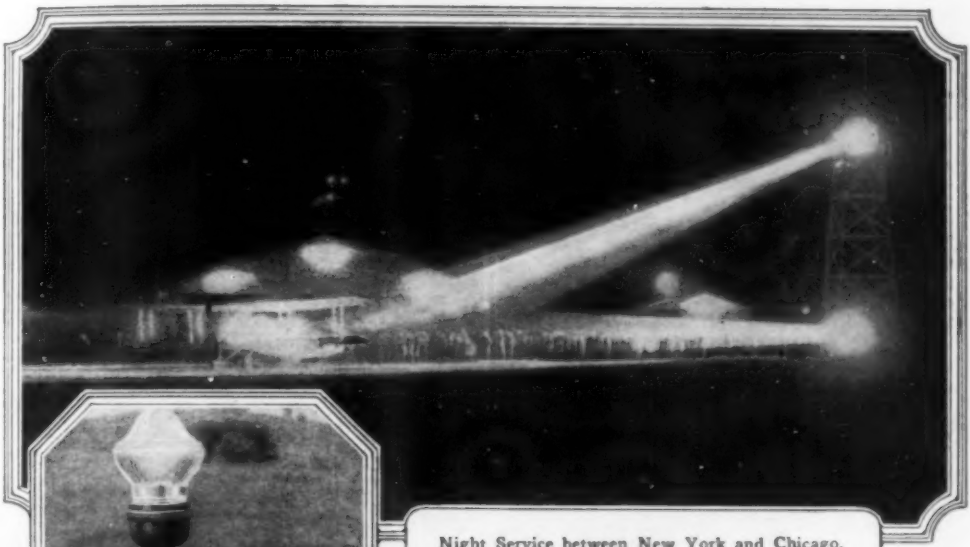


Besides Plane Lights, Pilots Have These Tubes Containing a Parachute Flare That Drifts Slowly Down to Guide a Forced Landing

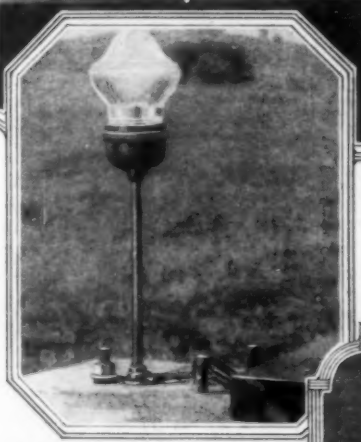
Winging Past the Six-Million-Candlepower Rotating Electric Beacon That Marks the Emergency Field at Night and Helps Direct the Flyers by Day with Its Tall Steel Tower; Planes Meeting at One of These Points for Transfer of Mail



Beacons That Guide Flyers across Nation



Night Service between New York and Chicago, Scheduled to Start July 1, Will See Duplications of This View, a Main Air Port with Both of Its 500,000,000-Candlepower Beacons Glowing



Sixty-Watt Border Lamp, Portable Beacon, and Left, Blinker Light; Set at Three-Mile Intervals, They Wink 150 Times a Minute, Go On Automatically at Night and Are Extinguished by Daylight

Where Old Papers Are Converted into Packing; the Shredder, Above, with Its Rows of Knives Slitting Sheets into Narrow Strips; the Cutter That Removes Glued or Stapled Edges, and an Armful of the Material Ready for Use

PADS BETWEEN SPRING LEAVES REDUCE AUTO BUMPS

Small rubber cushions have been devised for insertion between the leaves of automobile springs to reduce shocks. They are about the size of a nickel and have a small air hole in the center. The weight of the car reduces the rubber to about three thirty-seconds of an inch in thickness, thus compressing the air in the center pocket, and forming a resilient cushion that absorbs the jars and creates a suction which helps hold the device, because the latter is sealed by the leaves.

EXCELSIOR FROM WASTE PAPER CREATES NEW INDUSTRY

With the increasing scarcity and rising price of wood excelsior, a satisfactory substitute has been found in waste paper, and its manufacture has created a new industry. Plants are now established in Seattle, Detroit, San Francisco and other large cities, where old newspapers and magazines are cut into narrow strips for packing merchandise. The machinery required is simple, consisting of two types of cutters, one for removing the stapled or glued edges of printed publications and the other for shredding. The finished product is baled like straw. The process affords an additional market for gatherers of waste paper, the excelsior is lighter than wood, and, when made from unprinted surplus from newspaper and other publishing houses, is considered more attractive around fine articles, such as confectionery. Formerly this surplus was burned or returned to the factory.

LAUREL RIVALS BRIER FOR PIPES WITH LESS COST TO SMOKER

Doing away with the trouble and expense of locating and digging brier roots for the manufacture of tobacco pipes, an English expert claims that laurel wood can be worked into a valuable substitute at less than one-eighth the cost. Similar in appearance to the best grades of French brier, the laurel wood is first cleaned and cut into blocks which are placed in hot-water vats and allowed to simmer for about sixteen hours, or until the desired degree of coloring is produced. Pipes made from the material have a glossy surface, and are said to possess no unpleasant taste and to give a delightfully cool flavor to the smoke.

WOODWORKER HAS ALL TOOLS ON MOTOR SHAFT

A portable electric-driven woodworker, in which all cutting tools are mounted directly on the motor shaft, can be turned to any desired angle or moved along a horizontal arm to reach any part of the material being worked. The apparatus, which has been designed to save much hand labor on tasks where the material cannot be easily transported to stationary machines, is said to perform practically every operation required in woodworking. Owing to its light weight, it may be readily carried about by two men, making a handy tool for use by contractors, planing mills, and similar concerns, and because of its tilting arrangement may be employed for work that might otherwise call for larger special machines.

Tool on Its Swinging Mount Is Easily Tilted at Any Angle to Reach Corners

CLAMS AS PEARL "INCUBATORS" PRODUCE LUSTROUS GEMS

Production of pearls in such numbers as to make them available for buttons and ornaments at lower prices than those for which artificial pearls can be made, is announced as the result of a process

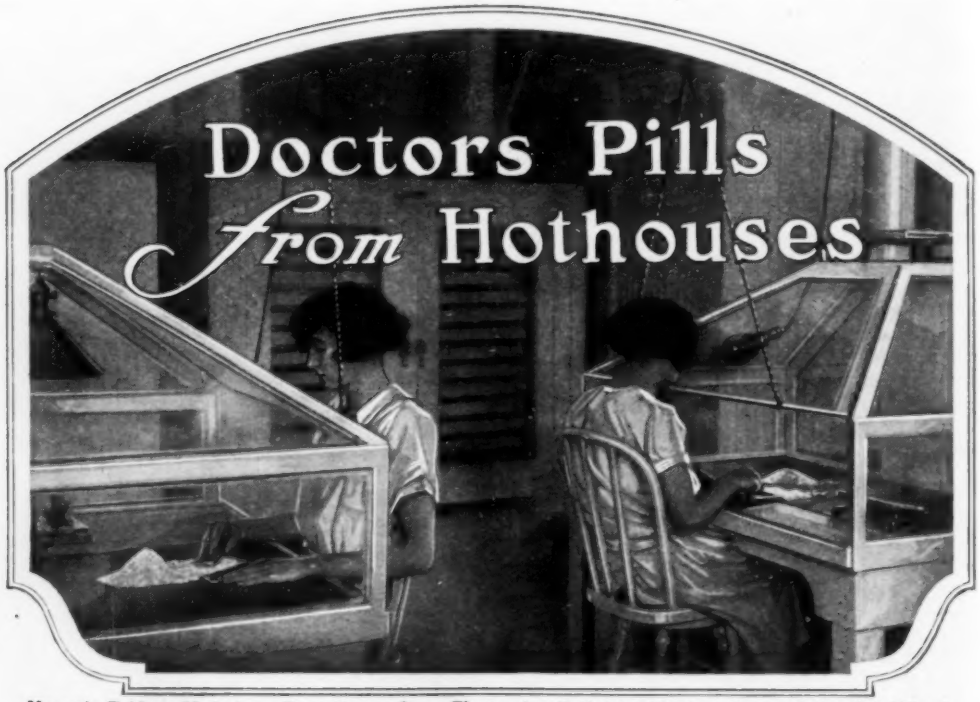
Examining Pearls in an Opened Clam; Young Woman Is Holding a Specimen Gem

of injecting a small organism into salt-water clams. This sets up an irritation on the fold of the bivalve, causing the formation of a number of tiny "seed" pearls. These are removed and inserted in the folds of other clams where they grow to considerable size and luster in a few months. The clam "incubators" can be used repeatedly for successive crops of pearls. They are kept in salt water at a higher temperature than that of the ocean and are fed to stimulate their growth.

RINGS ON SCALES OF SALMON REVEAL ITS AGE

Every year adds a series of half circles to the scales of the trout and salmon, according to John N. Cobb of the University of Washington, thus providing a clue to the age of the fish just as tree rings indicate the growth of the wood. The lines on salmon scales also reveal, roughly, the amount of food consumed each season. After a good year, with plenty to eat, the marks are wider than in lean years.

Doctors Pills from Hothouses



Narcotic Tablets, Made from Farm-Grown Drug Plants, Are Rolled by Hand to Insure Quick Solubility in the Physician's Syringe

GROWING the physician's pills and nostrums from hothouse seedlings to full-matured field plants has insured America's protection from disease regardless of wars or other causes which may cut off the supply of strange herbs from far-scattered lands.

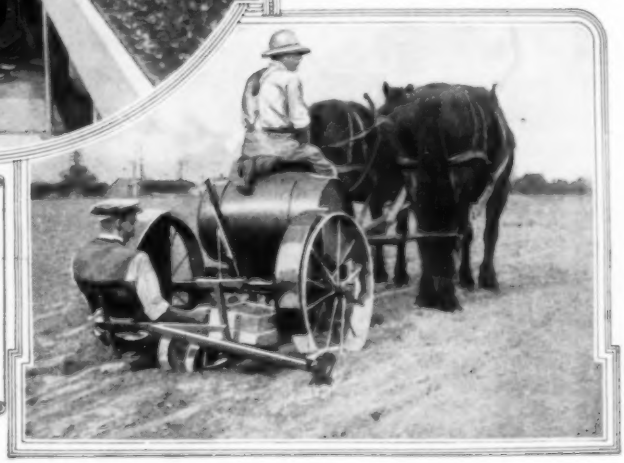
In times of peace and fair weather in the countries from which they come, most of the drug-giving plants can be produced more cheaply there in the wild state than over here under glass roofs and with higher-paid American labor. But when war or drought or other cause interrupts the foreign supply, the plant experts at a large laboratory and drug farm, near Indianapolis, are ready to step into the breach.

Thus, during the World War, when the usual supplies of belladonna from the old Austro-Hungarian empire were cut off, the laboratory not only produced enough of the drug to fill the inflated war demand, but by scientific cultivation and selection improved on the wild plant to get a strain which yielded more of the medicine. When peace came again and prices dropped, the wild supply undersold the cultivated, but the work of bettering the laboratory strain goes on, with a sufficient supply of plants to go into quantity production at any time. The same was true of atropine, the drug which the oculist uses to dilate the eye pupils, and which has many other medicinal uses. The usual supply is an Egyptian plant, which yields about one per cent of the drug by volume. Before the war the world's supply of the Egyptian plant was controlled by German chemists, and when the war broke out the imports to America ceased.

But the American scientists were equal to the emergency. In the stramonium, or common Jimson weed, which grows in profusion throughout many states, there was a possible supply of atropine. The Jimson weed yields less than half of one per cent of alkaloids, and only a part of that is atropine, but with enough of the weed, it was possible to meet the war-time demand, when large quantities of the drug were used by army doctors. The drug plant not only bought up tons of wild Jimson weed from farmers, but cultivated it and produced better strains.

An amusing incident occurred in the first rush to buy wild weeds when a newspaper advertisement, offering $20 a ton for the weed, appeared by mistake with the price fixed at $20 a pound. Before the error could be corrected, three farmers from a near-by village caught the next

Buchu, an African Drug Plant, Is One of Few Which Defy Transplantation to America, and It Is Still Taken to Market by Bullock Cart; Below, Harvesters Gathering in the Belladonna Crop on the Indiana Drug Farm



Belladonna Seedlings Are Grown in the Hothouses in Early Spring and Then Moved into Shifting Boxes for Transplanting When the Warm Weather Permits; Right, the Transplanting Machine at Work in the Fields, Carrying Its Own Water Supply for the Young Plants

Machine Like a Change Rack Sorts Pills in Rows of Twenty to Be Pushed into Slim Glass Vials Ready for Shipment to the Doctor

interurban with suitcases bulging with Jimson weeds, ready to sell them at 2,000 times the price which it had been intended to offer. And the laboratory gamely paid the price!

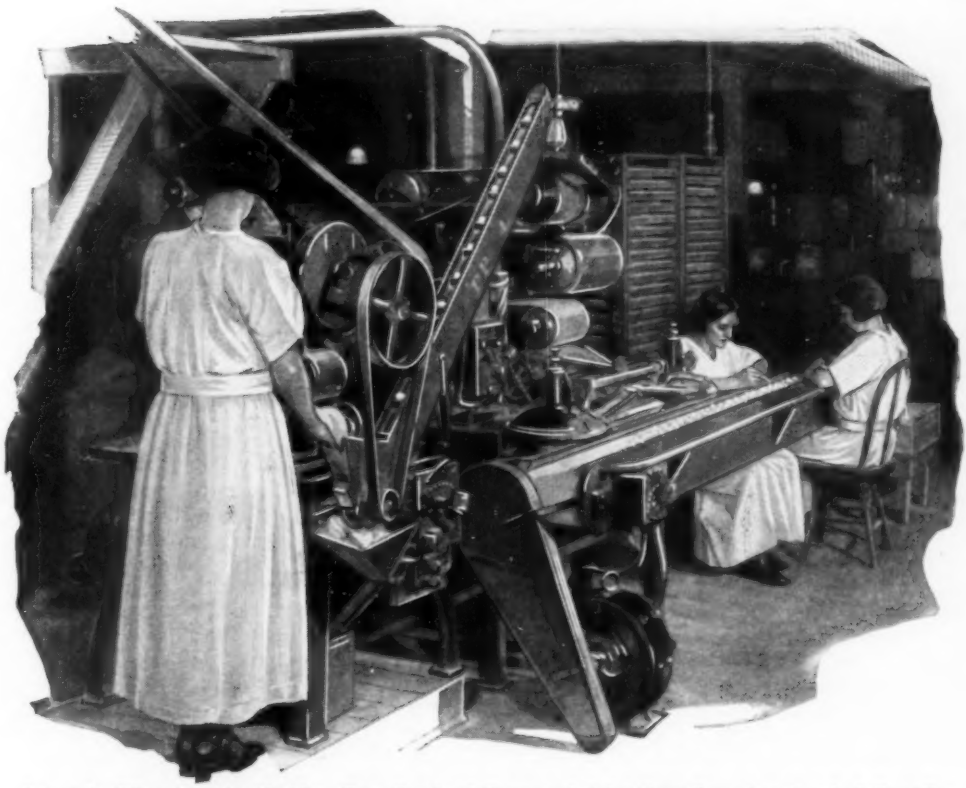
The plant laboratory has swept cannabis, a drug plant from India, out of the American market, because it can be produced more cheaply here. Cannabis is the plant from which the drug hashish comes, a mild narcotic which has many medicinal uses. The story of its introduction into America is a romance of the alertness of American scientists. The plant experts at the laboratory noticed that the Indian shippers carelessly failed to clean the plants thoroughly and remove all the seeds. So they began removing and saving the seeds, and found some that would germinate. When the war came and the cost of the Indian supply advanced, they were ready to grow cannabis in commercial quantities here, and ever since it has held the market.

Henbane is another mildly narcotic plant grown on the drug farm. It yields several substances, one of which is suitable for the narcotic preparation which produces twilight sleep. Even such prosaic things as oats are produced at the plant farm. Picked green, with the seeds stripped from the stalk by hand, oats is a useful medicinal agent. It is easier to raise it at the plant, where it may be stripped at the exact stage of greenness required, than to try to buy it green in the market. Carrots, too, are raised in quantities, but not for direct consumption as medicines. They go to feed the guinea pigs and rabbits which are used for necessary tests.

The plant laboratory is also experimenting with and improving many native American herbs, preparing against the day when advancing civilization and the dying out of the quaint profession of drug digging will exhaust the wild supply.

In the hills of the Carolinas, Tennessee and Kentucky and in southern Indiana, the drug diggers and herb doctors still flourish, practicing an art that has been handed down through families for many genera-

Rows of Gelatin Capsules Emerging from the Automatic Capsule-Making Machine



Automatic Pill and Tablet Machines Turn Powdered Drugs and Other Ingredients into Standard Remedies for the Doctor's Kit

tions. The backwoods people of the hill country still gather and dry their own herbs for home use, and sell the surplus to the itinerant buyers, from whose hands they go to small dealers. From them come the dried roots of mandrake, the rare golden seal and the ginseng.

At the laboratories the golden seal is being cultivated and improved against the day when the wild supply will have disappeared. A small grove is set aside for it, since the golden seal requires a deep leaf mold and shade at least half of the time. It takes seven years to grow a plant whose roots, when dug, can be held in the hollow of the hand. As the entire root is dug, the plant is destroyed each time and it takes seven seed beds to provide one bed for digging each year of the period. Digitalis is another drug which some day will be produced entirely from cultivated plants.

On the other hand, some of the medicinal plants will never lend themselves to cultivation outside their natural habitats, at least in commercial quantities, because of the peculiarities of climate required. In the drug warehouses at the plant stand rows of barrels filled with what appears to be cranberries. They are the saw-palmetto fruit, gathered from the swamps and marshes of the east coast of Florida, and dried under Florida suns to preserve their valuable oils, alkaloids, fat, rosin and glucose. In medicine, the extracts of the saw palmetto are valuable nutritives, tonics, diuretics, sedatives and expectorants.

Buchu is another rare medicine which, so far, has not been raised outside its native land—the wild mountain slopes of western Cape Colony, South Africa, where it flourishes at from 1,500 to 4,500 feet above sea level. The native gatherers climb the mountains and gather a load of a hundred pounds or so, then carry it back to the drying yard at some valley farm. The buchu bushes are usually well scattered, and the utmost yield from a full-grown one is six ounces at the time of cutting, and that drops to two ounces when dried. It usually takes a native two or three days on the mountainside to gather his hundred-pound load of buchu twigs, and after they have been dried and reduced to less than thirty-five pounds, the leaves are stripped off, and the twigs thrown

away. The leaves are then packed in bales and started overland to Cape Town, via bullock or mule cart.

After all the leaves and roots and other medicinal parts of plants are gathered into the warehouse of the drug factory, they pass through grinding and milling operations, cooking and steaming, until they have yielded their medicines.

As quantity production marks the cultivation of the plants at the laboratory, the manufacturing end resembles nothing so much as a high-speed automobile plant in full blast. Automatic apparatus produce pills and powders, fill bottles and ampules, and make capsules, while other automatic machinery seals and labels the output, and conveyor belts carry it away.

The capsule plant, which produces the containers into which many of the drugs will eventually go, alone has a capacity of a billion gelatin capsules a year. The purest gelatin, purer than that used as food, goes into the capsules, and to insure the proper texture, the weather in the capsule room is always late October. The walls and floor and ceiling are double, lined with cork; doors and windows are also double, and 750 water sprays moisten the air admitted, while electrically controlled heating and cooling coils keep its temperature at sixty-eight degrees.

Rows of slides, each bearing thirty capsule pins, all well greased, dip into the melted gelatin, arise with their coating, pass through a jet of air that sets the jelly, and then for an hour journey through the drying kiln, to come out and pass into a trimmer which cuts them off, removes them from the pins, and fits top and bottom together.

Inspectors take samples from every batch and measure them with machinists' micrometers to insure that the walls are only four-thousandths of an inch thick, for thin walls insure quick disintegration.

The atropine, henbane and cannabis extracts, if intended for sale in tablet or pill form, go with other ingredients to automatic pill machines for compressed pills, or to human pin rollers in small glass booths, who fashion them by hand in order to insure that the tablets will be quickly soluble. Machine-made tablets, being packed much more compactly, would take longer to dissolve.

The tablet forms of narcotic are sold in small glass tubes, hardly a quarter of an inch thick and just long enough to hold twenty tablets. An ingenious machine, something like a cashier's change holder, sends the tablets down in twenty rows, and the packer, with a long wire, pushes each score into a tube.

Filling Tiny Glass Ampules with a Sterile Solution of Tablets in an Automatic Machine

Automatic Conveyors as Well as Automatic Machinery Help Produce Medicines; Here the Bottled Drugs Are Passing from the Labeling Machine down the Production Line, Past Inspectors and Wipers, to the Final Shipping Point

Conveyor Systems Like Those of a Detroit Automobile Factory Convey the Various Medicines on Their Trip through the Dry Bottling Department, Which Puts Up Tablets and Powders

Photos Courtesy Eli Lilly & Co.

Racing-Boat Crew of the Warship "Wyoming" at Rowing Practice on Deck While the Vessel Is under Way; the Machine Was Built for the Purpose by the Ship's Mechanics

ROWING RACK ON WARSHIP FITS OAR CREW FOR RACES

Training facilities are provided for the racing-boat crew of the warship "Wyoming," so they can practice for contests while their vessel is under way. A heavy rack on which are strung weights attached to ropes, and designed to duplicate rowing conditions, is set up on deck during the drill hour. Under instruction of a coach, the oarsmen practice united movements and at the same time develop themselves physically. The training program was put into effect to keep the rowers fit for contests or water tournaments that might be held when the fleets reach ports. Much rivalry exists among the men of the battleships for first honors in the art of rowing, and championships of the fleets are highly valued by the competing teams and their shipmates.

FLATIRON HEAT IS CONTROLLED BY AUTOMATIC CUT-OFF

A lumber-camp furnace that he tended when fifteen years old, has brought a fortune to an eastern inventor. From the changing shape of its door under different temperatures he got the idea of a thermostat that automatically regulates the current to electric flatirons, percolators and like equipment, and his patent has been sold for a reported price of $1,000,000. The attachment consists of a small metal disk that changes its shape from concave to convex when a certain amount of heat is applied to it. This action controls an electric switch, cutting the current off when a flatiron, for instance, gets

© Keystone

Inventor John A. Spencer Adapting Regulator for Use as a Steam Trap

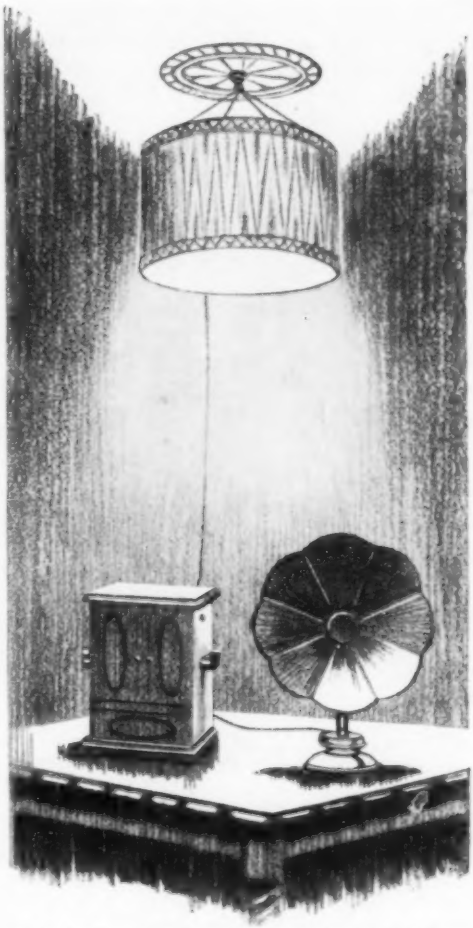
too hot, and turning it on again when it has cooled sufficiently. Even temperature is thus secured, the danger of scorching the clothing is decreased, and electricity saved. The secret of the regulator and the feature that distinguishes it from similar devices is that the energy stored with a rising temperature, is let go with a snap that is said to take only sixteen one-hundred-thousandths of a second, but is sufficiently strong to turn the control switch.

CARELESSNESS AS FIRE CAUSE BLAMED FOR MILLIONS LOSS

If carelessness and attempts to profit illegally from insurance could be eliminated, an annual fire loss of about $475,000,000 in this country, or three-fourths of the total destruction by flames, could be avoided, according to estimates. The insurance companies are doing what they can to reduce the total by constant vigilance over the causes of fires and in detecting persons guilty of arson. In cooperation with the board of fire underwriters, squads are maintained in various parts of the country, like units of a state police force, to investigate suspicious blazes. Every morning large insurance companies get a list of all the fires that occurred throughout the country the previous day. These are closely analyzed, the kind of business and the owners who suffered losses being noted.

FILING BOX FOR MEMORANDA HELPS KEEP APPOINTMENTS

As a memory aid to business men, an eastern inventor has devised a file box for memoranda cards that produces the slips on the date they are needed. It is a circular holder with thirty-one compartments, one for each day in the month. Cards are inserted in slots at the top. If an engagement is three days distant, the slip will be put in slot No. 3, if five days away, in slot No. 5. By turning a knob in the center of the box, these cards automatically are picked up and thrust through the proper opening so they can be withdrawn easily and examined. There is a calendar indicator on the knob to help keep the file up to date. The device is planned especially for persons who have to handle many details.



Radio Antenna Concealed in the Lining of Silk Lamp Shade Is Pleasing English Novelty

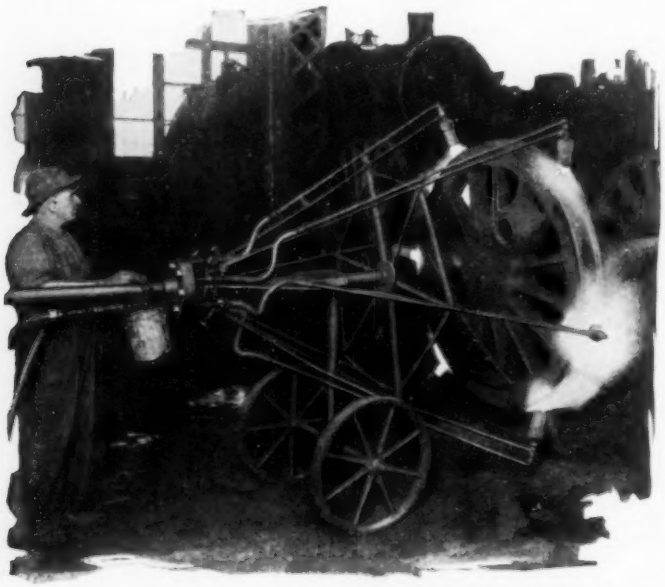
RADIO ANTENNA IN LAMP SHADE IS EFFECTIVELY HIDDEN

Within the silk lining of a special light shade a British firm is distributing, the radio antenna is effectively concealed, and the height of the holder above the set is said to increase noticeably the range of reception especially of small outfits. The shade is twenty inches in diameter with insulated upper and lower rings between which the antenna is woven in zigzag fashion. Best results are said to be obtained by fitting the shade in an upper room or hall and running the lead to the set on the outside of the house to the first floor. This gives still greater range because of the increased height.

¶More than 119,000,000 animals were slaughtered for food in this country last year, according to government figures.

TORCH TO HEAT ENGINE WHEELS REMOVES TIRES QUICKLY

Operated by compressed air, a circular oil-burning torch is in use in an eastern railroad shop to expand the tires on locomotive drivewheels so that they can be removed easily. Six jets of flame, at equal distances apart, are directed on the rims, evenly dividing the heat and concentrating it on the tire itself. The operator has constant control of both pressure and fuel. Tires can be slipped off in an average time of four minutes each, it is said, and the heater can be opened wider or narrowed to fit wheels of different sizes.



Courtesy Compressed Air Magazine

Heating Locomotive Wheel with Six Jets of Flame from Oil-Burning Torch to Expand Tire for Removal

SELF-SERVICE RADIO STORE SAVES HIRING CLERKS

Customers of a self-service radio store in Chicago can pick out parts for their sets at their leisure without bothering to explain what they want to clerks. It is operated on the same plan as an automatic cafeteria, the only attendant being a girl who makes change for the patrons. Prices are marked on placards, and the purchase money is dropped in small glass boxes with slotted tops. Customers are placed on their honor to deposit the correct sums. Besides saving time, the plan is said to increase the enjoyment of buying and hence add to the number of sales.

ANTI-RUST INSTITUTE FORMED TO COMBAT CORROSION

Scientists have started a world-wide attack on rust, the cause of an annual damage of not less than $300,000,000 in the United States alone, according to careful estimates, through the formation of a corrosion institute. It is the result of a conference among members of the American Chemical society and follows the adoption of more definite theories as to the causes of rust. Opinions on this question long have been divided. One group maintained that it was the result of electrical action; another, that it was purely chemical. In the meantime, corrosion has exacted its toll, with little check, on bridges, pipe casings, buildings, farming implements and many other articles. The institute will be at the disposal of both producers and consumers of metal products throughout the world, and the most practical ways of preventing loss from the age-old enemy of iron and other metals will be devised.

SHOE LACES OF SPRING STEEL ELIMINATE TYING KNOTS

Patented metal shoe laces that are inserted as separate units through the eyelets on one side and hook to those on the other, are being distributed by an English firm. They are manufactured in various sizes and colors and once fitted to the shoe, do not have to be removed. They eliminate the bother of tying strings, disposing of loose ends, are quickly fastened, and besides giving longer service, are said to add to the appearance of the footwear and to be more comfortable.

Necessity Is Forced to Mother Another Invention

TIRED of the labor of pulling nails from old boxes, too far gone to salvage, and then cutting up the waste wood into suitable sizes for feeding under the power-house boilers, an employe of the Ford Motor company evolved a plan for doing the entire trick by machinery, chalking up another invention to the credit of necessity.

The employe, however, did not know that Henry Ford had decided several years before that that particular invention should be made by one of his men. Nor did Ford, when he made that decision, know who the inventor was going to be.

Several years ago orders went out to Ford factories and branches that all waste lumber from packing boxes, freight-car braces, and other sources which could not be utilized in any manner, should be fed under the boilers instead of coal. The order solved the waste-disposal problem and did away with the old practice of throwing the discarded stuff on a bonfire. But it had one great drawback—it cost more to pull the nails and cut the stuff up into furnace sizes than to purchase and burn the coal of equal heat value. Branch managers viewed the expensive waste disposal with dismay, and finally a western manager took advantage of Ford's periodical visit to his plant to point out the losing proposition.

Novel Nail Puller, and, Above, Cutting Off Spikes with a Punch Press

"I know it costs more," Ford is reported to have replied, "but some day, somebody is going to get so tired of doing that job that he'll figure out a way to do it by machinery. So you just keep on as you are."

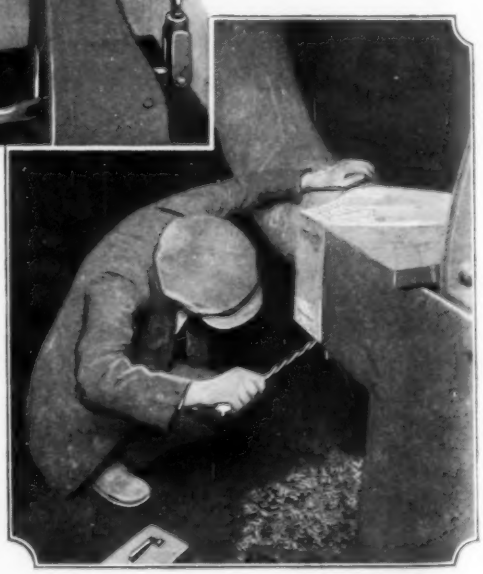
Less than a year later the somebody came through with the idea, which was simplicity itself. He simply fed the waste into a lumber-mill "hog," a machine with hardened steel knives, and there it was chewed up into sawdust. Nails mean nothing to a hard-working steel hog, and get badly chewed up, too. The combined

Scraps Dropping from Conveyor into Hog

sawdust and nails drop to the bottom of the hog, and there a ten-inch pipe, with a suction fan at the other end, draws the sawdust away, and leaves the heavier nails behind. Every hour or so a workman drops into the hog pit with an empty keg, opens an outlet door and draws off the accumulated nails. The sawdust at the Highland Park plant, is drawn up to a storage vat on the roof, and from there blown through nearly a quarter of a mile of ten-inch pipe to the power house where it is blown under the boilers in the same manner as powdered coal. Nothing goes to the hog, however, which can by any possibility be salvaged. The wood-salvage and waste-disposal plant is a structure 600 feet long and 100 feet wide. Two enormous conveyor belts run through it, which both extend for more than 100 feet at one end of the building, while one of them continues out as far at the other end, into the box-stacking yard.

At the intake end more than 170 truck loads of boxes, kegs and barrels, in which supplies are received at the factory, are delivered each day. They are placed on the conveyors and start down through the building. The first workmen turn out the larger pieces in the score or more of standardized boxes in which automobile parts are shipped. They accordingly pick off anything that can be sawed into the sizes they make. The next men make smaller pieces, and so on down the line until the smallest box part, three by four inches, is reached. Remaining sound pieces are utilized in the manufacture of specially shaped blocks and cleats for shipping and packing automobile parts, such as radiators and generators; tiny wooden forms used in the coil-unit assembly and jointed wooden mats for the entire organization. Anything that is left on the conveyor by that time is so badly splintered or damaged as to be unusable, and accordingly drops off the end of the conveyor into the gaping maw of the hog, to be chewed into boiler fuel. The workmen have made a number of other inventions to help dispose of the salvaged wood. One is a bench nail puller with a half dozen pulling claws cut in it. When a board with a nail in it is drawn across it, the nail head is caught in one set of claws and a downward push extracts the nail.

Foot-Power Press Used as Nail Cutter

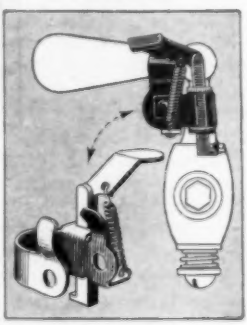


Cleaning Nails from Hog after Ground Wood Is Sucked up Conveyor Pipe Leading to Boilers

NINE THOUSAND NEW U. S. FLAGS USED BY POST OFFICE YEARLY

Most persons do not ordinarily think of the post office department as a large consumer, but its needs for a single year include more than 1,000 different kinds of articles ranging from acids to zinc, and many are purchased in enormous quantities. For instance, 757,330 miles of two-ply jute twine were ordered for the fiscal year that ended June 30, just to tie the letters into bundles, besides millions of yards of larger sizes of string, 30,000 pounds of cotton rope and 75,000 pounds of lacing cord for the mail sacks. Nine thousand new flags were needed to replace those that had faded or worn out. It took 4,000,000 cards to examine the railway mail clerks. The 52,000 post offices required 160,000,000 envelopes, 11,300 new letter and package boxes and 16,500 letter-box posts. Clerical departments called for 1,728,000 feet of typewriter ribbons, 4,323,000 sheets of carbon paper, 55,500,000 paper clips and 150,620 dozen pencils. Toilet necessities included 420,000 cakes of soap and 108,000 towels.

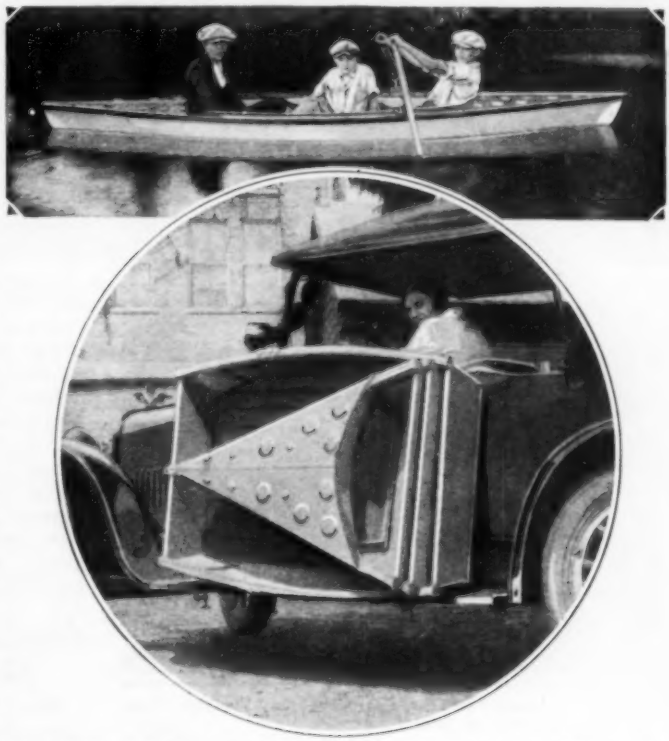
LOCK ON GAS COCKS PREVENTS ACCIDENTAL OPENING



Attachable to gas stoves, ranges or heaters, a patented safety lock prevents children or others from accidentally opening the cocks. It operates automatically, when the gas is turned off, by means of a spring and lever against the knob. It is simple to install, only one screw being needed, and for this reason is not likely to get out of order.

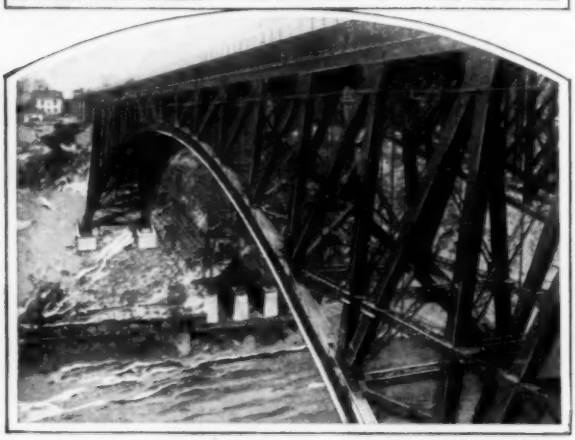
LIGHT METAL BOAT FOLDS UP ON AUTO RUNNING BOARD

For hunters, fishermen and others, a lightweight, collapsible metal rowboat, which can be carried on the auto running board, is now being marketed. It is manufactured in two sizes, the smaller thirteen feet long, with a beam of forty-two inches and weighing 140 pounds; the larger is fifteen feet long, has a forty-four-inch beam and weighs 160 pounds. They are constructed in two and three sections which nest compactly one inside the other, and are non-sinkable even when full of water, as they are equipped with air chambers. Channel-iron runners to brace the bottom, an embossed deck which does not get slippery when wet and movable seats are additional features. There is ample space for luggage, the boat can be set up quickly, and accommodates two persons besides sufficient equipment for a trip of a day's duration.



Boat Folded and Ready for Auto Trip; Above Is One of Same Kind, but of Different Pattern, as It Appears in Use

¶ One of the requirements of policemen at the White House is that they must be at least six feet tall.



New Niagara Gorge Arch Bridge, Below, Has Replaced Upper Structure, Which Is to Be Moved

OLD BRIDGE REPLACED BY NEW TO BE ERECTED ELSEWHERE

Replaced by a more modern steel span, the old cantilever bridge across Niagara gorge is to be taken down and erected elsewhere instead of being sent to the scrap heap. Built in 1883, the structure has required reinforcement but once, owing to the increase in weight of railroad traffic which it carried. The new steel arch which has taken its place is designed to accommodate much heavier loads, but the old bridge is believed to be sufficiently serviceable for duty at some other point where the traffic is lighter and the strain proportionately less.

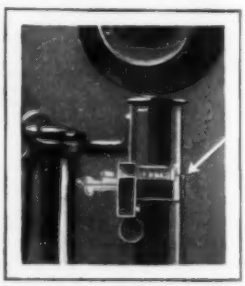
¶ Some ninety-four tornadoes occur in the United States every year. The death toll from these was nearly 550 in 1924. This year's total will be much larger because of the great storm that swept southern Illinois, Missouri and Indiana last March, claiming nearly 800 victims.

RADIO FATIGUES EARS TESTS SHOW

Ear fatigue from listening to radio has been revealed by tests held in the experimental laboratory of Princeton university. Contrary to the general belief, that the ears do not get physically tired, the investigations showed a noticeable reaction after the hearing of a subject had been directed on the sounds issuing from the wireless receiver. Strains from oscillating tubes were conducted to both ears of the patient in equal volume, then only one ear was permitted to hear for a minute. The sounds were again applied to both organs, and it was found the subject noted a decrease in intensity on the side which had been used alone. It is thought the findings of the experimenters will result in the development of a method whereby defective hearing may be improved or corrected by introducing series of special sounds capable of being heard by the patient.

METER CHECKS CALLS ON AUTOMATIC PHONE

Outgoing calls made on an automatic telephone can be counted and checked for comparison with service bills by a meter that eliminates improperly dialed numbers and wrong connections, and which may be easily fastened around the stand. Each properly completed call is recorded on a miniature numbering machine as the user hangs up the receiver. When connection is made with a wrong number, the device is prevented from registering by a small attachment operated by the subscriber, which also permits the receiver arm to be worked up and down without affecting the counter. The meter eliminates the need of keeping a list on which to mark each call. Its presence does not interfere with the working of the instrument, and it may also be used on the ordinary telephone.



Doing *the* "Impossible"

Examining a Short-Distance Rangefinder for Measuring Width of Canyons and Height of Mountains without Use of Rod and Chain

IF a scientist in the United States geological survey wants an instrument that will accomplish the apparently impossible, the call goes out for R. L. Atkinson, mechanic extraordinary of the bureau's instrument shop. His specialty is doing what every one else says can't be done, and in the five years he has been in the government employ, he has achieved a long list of victories.

Not long ago he took a piece of special metal turned out by one of the steel companies, and which was not only non-corrosive, but practically non-workable, and turned it into a special container for a thermometer used in taking temperatures in deep oil and water wells. When the officials of the steel company saw the work on the holder, they wrote, "we have never been able to machine this metal to such a fine measurement as was produced in this holder by your expert mechanician."

Machining the hardest known metals to unheard of degrees of accuracy is an old story with the expert of the geological instrument shop. He is at work now on what he expects to be the world's most precise telescope for level work. It will be used in obtaining accurate levels, the last word in differences in elevation. Every surveying instrument in ordinary use is slightly inaccurate because the exposure of their metal parts to sun, moisture and sudden temperature changes causes minute expansion and contraction. Atkinson's telescope is designed to eliminate these errors through the use of a new metal alloy which is practically "dead" to the effect of heat or cold. The expansion or contraction caused by a change in the temperature of one degree centigrade is figured at twenty-two hundred-millionths of an inch.

© National Photos

R. L. Atkinson and an Iguana, a Large Tropical Lizard, Shot by Him on a Hunting Expedition

Atkinson is only thirty-six years old, but in the last twenty years he has worked a bit in every machine trade from rebuilding locomotives down through fine engraving to watchmaking. He was a foreman of railroad and steam-shovel engine repairs on the Panama canal job as soon as he was old enough to pass the civil service examination, and, though only twenty-one, proceeded to invent a special tool for boring out both joints of a throttle at the same time, doing two days' work in one hour's time. At

twenty-four, he had exhausted the possibilities of the canal work and was back in the United States as assistant master mechanic of a Virginia railroad.

His present job as instrument maker for the geological survey dates from 1921, and he already has a long list of inventions to his credit, most of them, since government employes cannot patent their ideas, remaining his own secrets.

After completing his remarkably accurate temperature recorder for deep wells, which was his own invention, he produced the first exact rangefinder for short distances, vertical heights and horizontals. Ordinarily surveyors confronted with a deep canyon to measure, are forced to send a rod man across with a target at which to sight and then take cross bearing from two measured points. With the Atkinson rangefinder the surveyor focuses a telescope at one end of the rangefinder on any object on the opposite side, and then brings a telescope at the other end to bear on the same object. Both telescopes have micrometer head-screw adjustments, and when the cross wires are in line the angle reading is taken, and, as the base is known, a simple problem in triangulation gives the distance. The same instrument can be used to measure the distance between two horizontal points, or the height of a mountain. It has also been used in cave-exploration work, where a spotlight is thrown on wall or ceiling to measure heights and breadths.

Another of his inventions is a high-pressure apparatus for calculating the amount of oil in shale rock, or determining the porosity, or total pore space, in various kinds of rock. He made his own patterns, had the parts cast of phosphor bronze, and turned them up and assembled the apparatus. In using the instrument to determine the oil content of shale rocks, the shale is first weighed and then put in a cylinder, which is filled with water and subjected to a pressure of 3,000 pounds to the square inch, forcing the oil and water out of the rock. The oil is then separated from the water and weighed, giving a basis for computing the oil per ton of rock. The apparatus is also used to calculate how much water can be absorbed by the pores of building stones, information which is particularly valuable when selecting foundation material.

Atkinson's inventions cover a wide range. When a geological survey party prepared to make a trip through the grand canyon two years ago to survey the course of the Colorado river it was suggested that a radio set be taken along to keep the party in touch with the outside world during the several weeks they were down in the canyon. One of the largest radio manufacturers in the country declared no set could be built to work in the mile-deep canyon, where temperatures rose to 110 degrees by day, and where dry electric storms were daily occurrences. But Atkinson went to work and built a set, and it did work. The surveyors had daily news and musical programs, on one occasion picked up a broadcast warning of a cloudburst up the river and were able to move boats and equipment to higher ground before the flood reached them, saving both the equipment and their lives.

His success as an inventor and mechanic he attributes to his varied career, for many years never remaining in one position longer than was necessary to master all its details.

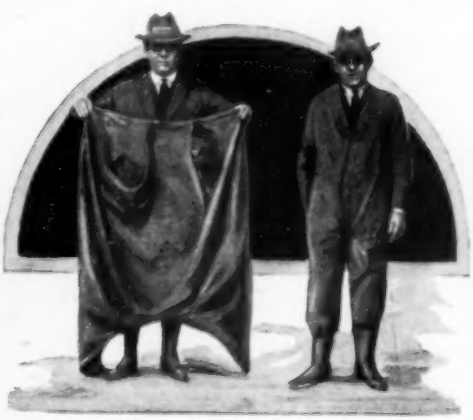
This Simple Little Outfit Measures the Pore Space in Oil-Bearing Shale, Building Stone and Other Materials by Squeezing Them under 3,000 Pounds' Pressure

PIGS GRAZED IN CORK FORESTS TO AID GROWTH OF TREES

The novel experiment of pasturing swine herds in the cork forests of Spain as a means to protect the trees against the encroachment of underbrush, is claimed to have proved successful. In the past, cork farmers have lost thousands of dollars every year owing to the undergrowths' draining nutriment from the soil and robbing the trees of their full amount of nourishment. At first the herds were hired from their owners by the foresters to feed upon the fruit of the trees, but the stock thrived so well on the fodder that the growers now charge rental fees for the pastures. Besides keeping the undesirable vegetation in check and increasing the cork yield per acre, the profit from the feeding grounds is said to add greatly to the revenue of most of the cork-growing enterprises.

OVERALLS PUT ON LIKE A COAT CLASP TO FORM TROUSERS

An overall suit which can be put on without lifting the feet to enter the trousers, can be donned as easily as a coat. When in place, a clasp arrangement may be buttoned to form separate leg coverings, resulting in a roomy one-piece suit that protects the clothing and leaves the limbs free. The garment, which is made of strong material, may be folded into a small package, and because of its simple adjustment and loose fit, makes a handy garb for carrying in a motoring equipment. In emergencies, the overall suit can be donned in a few seconds, and when taken off, leaves the clothing clean and free from wrinkles often caused by tightly fitting overalls.



Coatlike Overall Suit Spread Open, and as It Appears While Being Worn

PORTABLE OXYGEN TENT ON COT AIDS PNEUMONIA TREATMENT

Pneumonia patients are given oxygen treatments in a portable tent that fits tightly under the mattress of the hospital cot and is suspended from a cross rod above. The gas is administered from a tank with control gauges, through rubber tubing. Windows on both sides of the tent permit observation of the subject and let in light. The outfit is easily adjusted and can be used in almost any room.

Pneumonia Patient Receiving Oxygen Treatment in Hospital Ward While Resting Comfortably in Tent Attached to Cot

GASOLINE MEN CAUSE FAMINE IN DOLLAR BILLS

The increasing number of automobiles in use is given as one of the principal reasons for a shortage of dollar bills. Purchasers of fuel and oil at filling stations usually use paper money as the medium of exchange. The gasoline dealer handles the bills with greasy hands which quickly deface the bills, necessitating their early return to the treasury. The average life of paper money has been about eight months, but this is rapidly diminishing, it is said.

Typical Chinchilla Rabbit, Above, and a Jacquette Manufactured from the Skins of Animals Raised in the West
A Wool-Bearing Angora - Rabbit Buck from the Farm of Lady Rachael Byng, Wife of England's Famous War Hero
Real Live Chinchilla Lanigera, Rare South American Animal, from a Herd Now Being Raised in California
White Angora Rabbit, Right, with Full Crop of Fine Wool Ready to Be Plucked and Sent to Spinners; Below, a Himalayan Rabbit Doe, Whose Pelt Will Go to Help Furnish Milady with a Fine Imitation-Ermine Wrap

Courtesy Golden West Farms

Growing Fur Coats on Farms

WHEN milady wants a new fur coat, or the aviator orders a nice fur-lined flying suit a hunter or trapper doesn't depart for the wilds, to spend the long winter months, undergoing cold and privation, to trap the fur.

Instead one of Uncle Sam's twelve-hundred-odd fur farmers walks down to the pens after breakfast, picks out a few likely-looking animals, examines their pelts carefully to determine their value, and proceeds to gather in the best of the lot to be converted into coats, neckpieces, flying suits, lap robes and other articles.

Fur farming nowadays is as much of an organized business as any kind of live-stock raising. The growth of the industry in the last twenty-five years has been notable. From early efforts toward raising foxes, the fur farmers have branched out until nearly every sort of marketable fur is being grown at home in farm pens. Silver foxes continue to lead, with more than 500 farms devoted wholly or in large part to them, but the list of farm-grown fur animals includes also blue, white and red foxes, marten, chinchillas, fisher, mink, raccoon, muskrat, several varieties of rabbits, and even the seals of the Pacific ocean are farmed by the government at the Pribiloff islands. The silver-fox ranches alone have more than 15,000 animals in captivity with an investment value of $8,000,000, while the total in all kinds of fur farming is estimated by the department of agriculture at between $12,000,000 and $15,000,000. What the total annual output of all the ranches is no one knows, since fur-farm statistics are still incomplete, and total-sale figures include both wild and farm-grown fur. The returns, however, are enormous, the department of agriculture estimating that no form of live-stock raising pays such dividends on the capital invested.

The great value of silver fox pelts is due to the fact that it is virtually impossible to substitute a skin of some cheaper animal for the genuine article. The difficulty in faking lies in the silver guard hairs from which the animal takes its name. Each silver hair is really of three colors, in a white, gray and silver combination of bands, and it is this color banding which prevents dying guard hairs in another pelt to make a fake silver.

The ranch-raised foxes become very tame and are handled as easily as dogs. Each pair has a wire cage containing from 650 to 1,500 square feet, and a kennel or

Wearing One's Furs Alive on L. O. Holman's Raccoon Farm, Where the Animals Are Trained as Family Pets

den, which sometimes is constructed underground, and at other ranches above ground, usually with double walls as a protection against cold. The larger ranches are usually laid out, if the ground conditions permit, like the spokes of a wheel, the rows of cages stretching away in every direction from a central lookout tower. During the breeding season, and until the pups are big enough to come out in the open, the foxes are very shy, and the lookout tower permits the rancher to keep watch over his animals without annoying them by his continual presence. During the season from early in the year until late in April visitors are not admitted to the ranches, and the workmen who care for the animals even wear the same clothes through the entire season in order that no strange odors may alarm the animals.

Many of the mother foxes are permitted to raise their own young, but in the case of nervous animals, which may injure their pups, the litter is removed and placed in charge of a house cat. Some ranches keep as many as twenty or more cats for this purpose.

Raccoon, mink and muskrat are raised by several ranches successfully, and in the northwest experimenters with fisher and marten are reporting success, although the supply of ranch-bred animals is still limited.

Blue foxes and the rare white fox are being ranch-grown in Alaska, where the wild supply of fur-bearing animals has been much depleted. Alaska is well suited for fur farming. The cold winters produce prime fur, the islands which dot the

White-Fox Fur Neckpiece, Made from Skins Produced on an Alaskan Ranch

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Fisher, One of Six Rare Ones, at Rest Island Silver-Fox Farms

Beaver, Above, Farmed in a Marsh; and Right, Two Silver-Fox Pups

coast present isolated sites from which the animals cannot escape, and food is plentiful and cheap. The salmon industry offers cheap food in the summer, while thousands of rabbits are killed, the meat dried and pulverized, and stored in sacks for future feeding.

The biological survey has a unique fox-farm industry on the Pribiloffs in connection with the seal-fur work conducted there. The seals may be said to be farmed, since the government has a monopoly on the business and owns the rookery islands where the seals come each spring. The government is careful to protect the seal herds, and each spring, before killing starts, a government official, mounted on a tall tripod, takes a careful census of the animals and determines how many bulls of each age may be slaughtered. Cows are never killed, except by accident. As fast as the seals are killed and skinned the carcasses go either to the seal-oil factory, or else are salted and packed away in a peculiar kind of silo, built into the side of a hill. During the summer the immense packs of blue foxes run wild on the islands, living off such food as they can get for themselves. When winter sets in, the time comes for feeding. A spring is diverted into the silo and the water allowed to run through it for several days, until the salt is washed away. Then the

Tame Silver Foxes at the Hercules Fur Farm

Pair of Pups, Full of Curiosity But Not Sure of Their Legs, at the Rest Island Silver-Fox Farms

Baby Raccoon Raised by the Bottle Route

Typical Fox Farm Layout, One of the Pontiac Strain Units

meat is placed out in the open for the foxes. Several days later the meat supply is moved to a big wire cage during the night, the cage door remaining open. Soon the animals become used to entering the inclosure to feed. A man is stationed in the trap building, and as fast as the cage fills up with anywhere from a dozen to fifty animals he pulls the rope, closing the door. The foxes are then shooed into the trap house, the door is again opened, and another cage full caught. In the trap house the animals pass from the receiving room on into a retaining room, and from that through a small door they go one at a time into the killing and skinning room. As the native skinners catch up each animal, a government agent examines its coat to make sure that it is in prime condition, and, if the fox is a female, decide whether it shall be freed for breeding purposes. The latter are turned out through a release trap, and the others killed and skinned.

Rabbit farming, producing cheap pelts which may be converted into imitations of many rare furs, including ermine and chinchilla, has also become quite an industry, particularly in California. By careful selection and breeding several varieties have been developed which are easily converted into imitations that defy detection by anyone but an expert. The raising of angora rabbits is also proving a profitable side line, since the angora yields its fur without the necessity of killing. The animal gets its name from the resemblance of its fur to the wool of the angora goat. The

wool is plucked four times a year and sold to be converted into fine woolens, much prized for baby blankets and other finely made articles. These rabbits require considerable attention, however, since each one must have his wool combed every few days to keep it from becoming matted. A chinchilla-type rabbit has also been produced by fur farmers, and one of them has succeeded in transplanting the real animal from South America.

With the exception of rabbits, most of the fur ranches require a locality where the winters are fairly long, and cold, to insure prime fur. Hot summers are not a detriment, provided the winter season is long enough for the fur to develop. In fact, the climate in Michigan, Wisconsin and New York has proved better for fox ranches than places farther north, since the warm spring gives the early-born young a better chance to live.

Success in any of the fur-farming lines requires considerable knowledge of the habits of the animals, their care, and sufficient capital to last over the early years of getting established. The rancher must also be well grounded in scientific breeding, since inbreeding is fatal to the stock. The best ranches carefully mate an animal that is deficient in one point and strong in another, to one that is strong in the first and weak in the other, in order to insure that their offspring will strike a better average in both.

The Census Taker Climbs a Tripod Ladder When He Counts Noses in Uncle Sam's Seal Herd at the Pribiloff Island Rookery; Insert, Wild Blue Foxes Are Fed in Winter from the Summer's Seal Kill

Upper Photo © G. Dallas Hanna

PROPELLER FOR BOAT OR PLANE ALSO ACTS AS RUDDER

A propeller, capable of driving either airplanes or water craft and said to dispense with the need of a rudder, has been invented by Prof. F. K. Kirsten, of the University of Washington. Installed on a vessel, the driver can be operated with equal success for forward or reverse movements. As an aid to steering, the apparatus is claimed to serve as a rudder, permitting more complete control of the directional motion of the ship, without impeding the propelling power. One of the propeller-rudders, fitted to a seventy-foot boat, has been found to produce greater ease of steering and a more accurate response to the helm.

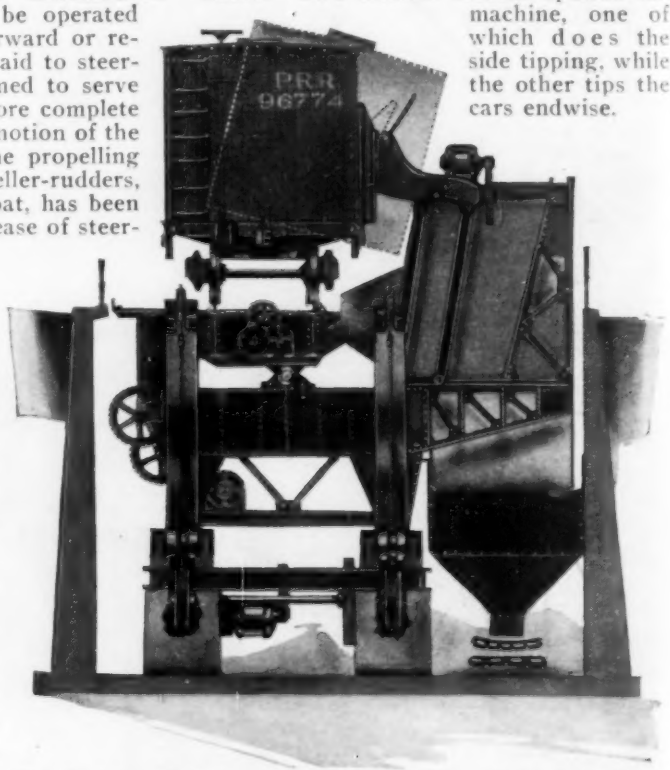
Combination Propeller and Rudder Which Can Be Adapted to Either Water Craft or Airplanes

RADIUM BATTERY EVERLASTING

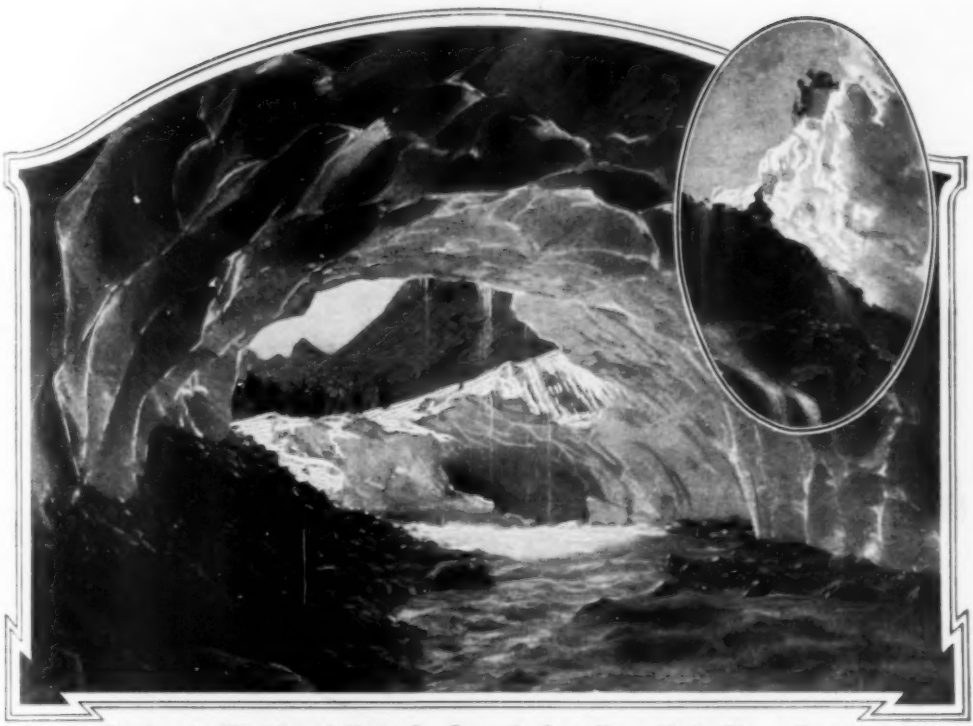
The possibilities of a form of electric battery which would be practically everlasting were discussed by J. B. Kramer, a British scientist, recently. The new cell uses a radioactive material such as monazite sand in place of the usual chemical electrolyte. It was found that if the space between the two plates of different metal was packed with radioactive material, a steady current was produced. With zinc-carbon elements, a potential of more than a volt was obtained from a single cell. The duration of the life of the battery would presumably be limited only by the life of the radioactive substance used.

AUTOMATIC BOX-CAR DUMPER DOES WORK QUICKLY

To reduce the cost of emptying grain from box cars and allow them to be released quickly for service, an automatic unloader has been designed which completes it work in three and a half minutes. As the car is run onto the tilting track, a special attachment on the machine lifts the grain door, and the car is tipped sidewise and the contents poured into a gigantic hopper. To remove the material from the ends of the carrier, it is turned endwise at an angle to force the grain toward the center and out the door. After the unloading operation, the car is replaced on the track and the loosened door automatically deposited on the floor undamaged. With proper haulage facilities, it is claimed the unloader can handle sixty-four box cars in a working day of eight hours. Two electric motors operate the machine, one of which does the side tipping, while the other tips the cars endwise.



How the Automatic Grain Unloader Tilts a Box Car to Empty It; Three and a Half Minutes Are Required for the Operation



Fantastic Interior of a Wind-Carved Glacier Ice Cave; the Inset Shows Motion-Picture Cameramen Holding a Mirror at the Cavern's Entrance to Reflect Sun's Rays into It

ICE CAVES LIGHTED BY MIRRORS FOR TAKING MOVIES

By the skillful use of mirrors, a motion-picture company not long ago obtained spectacular views of the inside of several of the beautiful wind-carved ice caves of the Nisqually glacier in Mt. Ranier national park. Men at the entrance to the caves, held the glasses in such a way that the sunlight was directed to the interior where the cameraman was stationed. Other mirrors picked up the reflections and cast them back against the rocks and the grotesquely outlined ceiling of the cave, bringing out the deep etchings that the wind and warm air currents had carved in the ice. Considerable danger attended the task as great pieces of the glacier broke off from time to time while the men were at work. The caves have not been accessible for several years, it is said, and only three consecutive warm summers made the feat possible.

¶There is now an automobile for every horse in the United States, and by the end of this year, it is estimated, the number of cars will be considerably greater. Ten years ago, there were nine horses to one auto.

LINER GAUGE FOR TYPESETTERS IS EASILY ADJUSTABLE

A variable liner gauge for typesetting machines that cast lines in a solid piece, can be adjusted for any of forty-six different measures and is said to replace the large number of gauges usually required with composing outfits. The liner, which is patented, can be quickly set to a size, and is provided with a micrometer screw for adjustment to bastard measures. Owing to its special design, the gauge is claimed to eliminate the breaking of slugs through careless operation of the machine. Even where the cap on a mold is warped or bent, the gauge will make perfect slugs. In use, it prevents projections of metal beyond the end of the line, "back squirts" of metal caused by imperfections often present in the old-style liners, and damage caused by using the wrong ejector blade.

The Revival of Archery

IN a little shop at the rear of a dwelling in a side street of Jersey City, N. J., are made by hand most of the bows and arrows used by the foremost archers in the United States. In this age of specialization and ponderous machinery, James Duff, the proprietor, still plies his ancient craft. The wood from which the bow is fashioned is lemonwood, imported from South Africa. It is seasoned for seven years. Arrows are fashioned of Norway pine. The Flemish bowstring has been manufactured by one family in Belgium for the past 300 years. Every implement is made to order, and the purchaser specifies the poundage he wants it to register when drawn. The great skill of the craftsman may be gauged by the fact that he is rarely more than an ounce or two out of the way when he makes the first test. Although lemonwood is quite hard, the tremendous pull of the string when the bow is in use would soon cut through it. A material of extreme hardness is, therefore, necessary for the tips, and for these the craftsman goes to South America, it having been discovered that the horns of South American oxen are best suited for this purpose. Tips are cut to fit over the ends of the bow, glued in place, and then notched for the string. The Norway pine arrow stock is cut into thirty-inch lengths, one-half inch square. Arrows are made to weight, and by an ancient system. Instead of the usual avoirdupois weights, shillings and pence are used. The average arrow weighs from four shillings six pence to five shillings, and the weight is specified by the purchaser. One of the most delicate operations in the whole process of arrow making is the insertion of the turkey-buzzard feathers in the shaft. Three incisions are made at one end of the arrow. The quills are shaved to the thickness of the feather itself, and are then coated with glue and set in the cuts on the arrow's surface.

If Bows Are Too Stiff, They Are Reduced by Shaving Them Down with a Hand Scraper as Above; Below, Weighing an Arrow after the Old English Fashion of Balancing It with Shillings and Pence; the Weight Is Still Stamped on Arrows in Figures That Represent the Coins with Which They Were Balanced

Making a Target from Straw, Tied into a Thick Rope and Sewed into a Coil to Form a Back for the Painted Cover; Below, Shaping a Bow in the Rough from a Piece of Lemonwood

Bag Closed, and Open to Show Suit Laid Flat over Rack, and Drawer That Holds Accessories

V-SHAPED RACK IN HANDBAG KEEPS CLOTHES PRESSED

A "valet bag" designed to keep two suits of clothes as carefully pressed as though they were hanging over the tailor's rack, and also accommodate shoes, hats, and a supply of shirts, underwear, collars, ties, handkerchiefs and other wearing apparel, has recently been placed on the market. Slightly larger than an English kit bag, the new invention is unique in that it contains an inverted V-shaped interior rack on which the suits hang. A drawer inside the rack and large side pockets hold the other articles.

CHAMELEON CHANGES COLOR BY SHIFTING CELLS IN SKIN

Packed away in the true skin of the chameleon under the outer covering, are several layers of tiny cells, the movements of which cause the changes in color. Those at the top are filled with minute crystal-like grains that reflect the light and make the creature appear almost white. Below, the cells contain a yellowish oil and deeper still, a reddish-brown pigment. Different combinations give a whole range of colorings, and the movements are caused by contractions of the skin. The chameleon's eye is believed to effect the changes to some extent. In dark surroundings, it is lightly stimulated and little if any "turn" in color occurs. Different shades act upon the eye in varying degree, causing the chameleon to arrange its color cells accordingly.

TUBES THAT WON'T BURN OUT BOON TO RADIO FANS

Vacuum tubes for radio sets of the future may have their life prolonged indefinitely by a new filament which works at a temperature much lower than the ordinary bulbs. The material, which was described by Dr. Irving Langmuir, of the General Electric company, accomplishes its purpose without heating to a glow, and even in a dark room does not appear red under operation. By the addition of a small amount of thorium, combined with several gases, to the tungsten used in the tubes, the filament is made to operate at temperatures far below the usual danger point, avoiding overheating to the burning-out stage.

SPRING TOP FOR TOBACCO POUCH REDUCES WASTE

Easily mounted on the tobacco pouch or bag, a metal top with spring jaws that automatically close tightly and are opened with slight pressure, keeps the contents from spilling and simplifies filling the pipe or cigaret. The attachment is oval so that it fits easily in the pocket and permits the tobacco to run out in a narrow stream.

Tobacco-Pouch Top Detached and in Use in Place of Ordinary String Fastening

Foreign matter cannot get into the sack when the jaws snap shut and the bother of loose and unhandy strings is eliminated.

MOTOR PUSHED ACROSS DESERT TO SAVE AIRPLANE

Hardships of the early pioneers were reenacted with a modern twist not long ago when a 700-pound motor was pushed by hand, three and one-half miles across the burning sands of Death Valley in California and installed in an airplane that had been forced down by failure of its engine. Wooden rails were laid upon the shifting dunes, the ponderous motor, in its frame, mounted on skids, rollers were put under them and the laborious journey started. Five men accomplished the hard task without any other mechanical aids, marking their pace against a fast dwindling water supply they carried in their canteens.

Rolling the Motor across Sands, Adjusting It on Plane and the Workers Carefully Measuring Their Water Supply

ROOSEVELT EXPEDITION IN ASIA FACES MANY PERILS

The route of the Roosevelt central-Asiatic expedition is probably one of the most difficult in the world, according to big-game hunters. It lies through the Pamir highlands to the northwest of Tibet where the "miles stand up on end" between deep mountain valleys. Glaciers, avalanches and slippery trails are a constant menace and the high altitude, often more than 17,000 feet, causes the traveler great discomfort. Water boils at a temperature of only 178 degrees here so that foods can be only half cooked. One explorer boiled beans four days but they were still underdone. Snows and blizzards usually choke the trails to the south by the first of October, and if the travelers are delayed beyond this date their difficulties will be increased greatly, and they may have to remain in the region all winter. Scores of coolies and animals will be required to carry the needed food supplies. One of the principal objects of the expedition is to bag a specimen of a rare mountain sheep believed to be the ancestor of the modern domestic variety. Marco Polo, the famous traveler who penetrated Asia in the thirteenth century, described this animal as a large species with long horns out of which the shepherds made bowls, and even fences to inclose their cattle. Wild camels, boars, long-haired tigers, Arctic bears and snow leopards will also be hunted.

COVER ON AUTO-TIRE PADLOCK PREVENTS RUST AND MARS

Neatly inclosed in a durable leather cover, padlocks for spare auto tires are protected against rust, cannot rattle and will not chip or scratch the finish of the car. Access to the key opening is easily gained by unfastening a flap that keeps the cover from falling off.

With Women in the Field of Science

Miss Annette Ashberry, First Woman Member of the English Society of Engineers, at Her Lathe; Right, Miss M. W. Hooker, a Radium Expert

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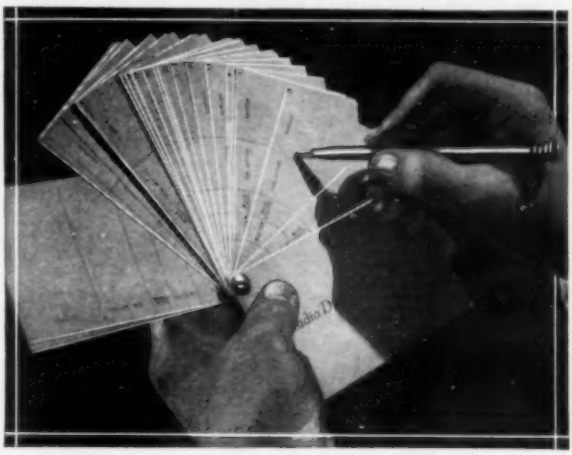
Miss Olive French, Chemist of Simmons College, Analyzes Milk to Determine Its Butter-Fat Content

Miss Ethel Peyser, Household Engineer, Who Tests and Gives Advice on All Sorts of Labor-Saving Devices for the Home, Installs a Generator

RADIO DIAL-SETTING RECORD OPENS LIKE A FAN

Radio fans who like to keep a written record of dial settings for different stations, are spared the inconvenience of a large book or an unhandy chart in a compact card file that opens up like a fan, has spaces for the names of the cities, stations, wave lengths, dial readings, and remarks, and keeps the information in alphabetical order. It consists of a pack of ordinary index cards, properly ruled, and held together by a strong screw at one corner, permitting the leaves to be spread apart quickly without unfastening them. A back and cover protect the cards, and new ones can be added when needed. The entire record can be kept in a corner of the set.



Radio Log Cards Held Together by Screw Spread Out Like Fan for Quick Reference

AIR-DRIVEN ROAD SMOOTHER SAVES TIME AND COST

Bumps and high spots in concrete roads are removed at one-tenth of the cost of hand labor, according to reports, with a portable compressed-air outfit consisting of a motor-driven compressor and drill on two wheels. A workman who never before had used the machine is said to have resurfaced thirty square feet of high spots in two hours. The apparatus is also adapted for making cable ducts in cement floors. The trench is first cut, then a thick elastic rubber tube laid in it. Concrete is next poured over it and after it has set, the rubber is pulled out, leaving the duct ready for the insertion of cables.

Smoothing Off Bumps on Concrete Pavement with Portable Drill Driven by Air Which Is Compressed by Motor at Right

WORLD'S SUPPLY OF RADIUM LESS THAN HALF A POUND

Since Mme. Curie discovered the precious element in 1898, less than half a pound of radium has been produced, according to Dr. Charles H. Viol of Pittsburgh. Small as this quantity is, it represents an almost unbelievable amount of work and has an estimated value of $15,000,000. Enormous quantities of ore have been handled to obtain it. For instance, more than 500 tons of carnotite, found in Colorado, are required to yield only one gram of radium, and the refining of the ore calls for as many tons of chemicals, 1,000 tons of coal and 10,000 tons of distilled water. The radium bromide extracted fills only half a thimble. Radon, the radium emanation used in treating disease, being a gas, has a much greater value weight for weight, but from $25 to $50 worth of it will treat conditions that would require from $2,000 to $4,000 worth of pure radium.

FIGHTING FIRES *from* TRAINS

WITH three-fifths of our original timber already gone, and the demand four times greater than new growth can supply, vigorous steps are being taken throughout the country to preserve the remaining forests and to plant new ones. Last year, 16,000 federal, state and private rangers were in the field, stamping out campfires and stubs left by careless persons and smokers of the horde of 11,000,000 visitors who roamed our 146 national forests.

A railroad in California is doing its bit toward saving the forests with a battery of four fire-fighting trains. They are stationed at strategic points along a snow-shed section, especially to protect the structures and the woods near by from sparks from the engines. Each train consists of a standard ten-wheel locomotive and two tank cars, which hold between 20,000 and 30,000 gallons of water. Ladders, axes and 1,000 feet of hose are included in the equipment of each unit. The pumps are operated by steam from the locomotive and each has a capacity of 300 gallons per minute.

At the summit of the line, nearly 8,000 feet above sea level, observers are stationed in a fireproof concrete tower throughout the dry months to watch for suspicious curls of smoke by day and the telltale glow of a fire at night. A glance at a specially designed surveying instrument and a map showing every tunnel, mile post and signal box along the section, tells the location and character of the blaze. If it is merely a travelers' campfire, started too close to the sheds, men are dispatched to move the campers to a safer distance and put out the fire. But if the timber is burning, an electric alarm from the tower to the nearest fire-engine house, sends a train and its crew speeding to the scene. Steam is always up and the men ready for duty twenty-four hours of the day, just as in any city department. If the fire proves serious, other trains are sent to assist the first unit. Alarm boxes are installed in the sheds so that track walkers and laborers can call out the trains in emergencies when the observers fail to see the blaze. The cost of maintaining the unique fire department, it is declared, is money well spent without counting the saving represented in preventing the spread of blazes that might burn far into Uncle Sam's and private forests.

Two Big Tank Cars of Water, Pressure and Plenty of Hose Win the Battle

Fire Engine of the Rails Fighting the "Red Enemy"

Courtesy Southern Pacific Ry. Co.

BALL-AND-SOCKET STEPLADDER LESSENS DANGER OF FALLS

A safety ladder for light work and household use has been designed to resist

Safety Ball-and-Socket Ladder That Can Not Be Overbalanced by an Uneven Footing

tipping or overbalancing. No matter how any one of its four legs may be elevated, the other three are said to remain firmly in position, insuring a substantial footing without risk to the worker. Often hastily placed ladders are thrown off balance by unnoticed objects under the supports, but the tipless device is claimed to stay upright even in such a case. Constructed like two ladders, hinged at the top with a ball-and-socket joint, the structure can be readily handled and folded when not in use.

¶Wooden airplane frames will soak up more than 100 pounds of water on a damp day, it has been found.

FEW BIRDS ARE HIGH FLYERS AIRPLANE PILOTS FIND

No air pilot has reported birds higher than 12,000 feet and most of them do not rise above 1,000 feet, according to a German scientist. The bluethroat, believed to be able to fly at the rate of 200 miles an hour, in reality cannot do better than twenty-five, airmen interested in the study of the feathered flyers declare. The chief difficulty in observing birds from airplanes is that the machines cannot go slowly enough to follow them.

ELECTROPLATED OVERCOATS

A method of plating fabrics with a leakproof layer of rubber, similar to the electroplating process to coat metals with other metals, was reported to the American Chemical society by Dr. S. E. Sheppard. Cloth may be made up into completed garments and the apparel electrically treated with a covering that repels all moisture and avoids danger of parting at the seams, the scientist claimed. Owing to the additional strength given the fabrics by the rubber plating, rips will be prevented, and the surface of the cloth preserved against wear. The process is said to eliminate many of the operations now required in the manufacture of rubberized waterproof cloth and simplify its assembly into garments.

COVER ON PIPE FOR MOTORISTS IS ADJUSTABLE TO WIND

A pipe with an adjustable cover for the use of motorists is designed to overcome the annoyances of having tobacco, ashes and sparks blown about by the wind while driving. The top can be rotated so that the closed section is presented to the wind, leaving the open side undisturbed. Even when traveling at high speed, the autoist may enjoy his pipe without having it fanned to uncomfortable heat by the rush of air, and the tobacco is allowed to burn slowly avoiding injury to the wood. The pipe also may be smoked in heavy rains as the lid is ample protection against entrance of water. A hinge is provided so the lid can be thrown back to fill the bowl.

© C. A. Oldroyd

Playing the Popular War Game of Battle Ball in Which Skill of Hand and Eye Is Required to Aim and "Fire" the Toy Guns

EUROPEAN WAR GAME LATEST FAD IN AMERICA

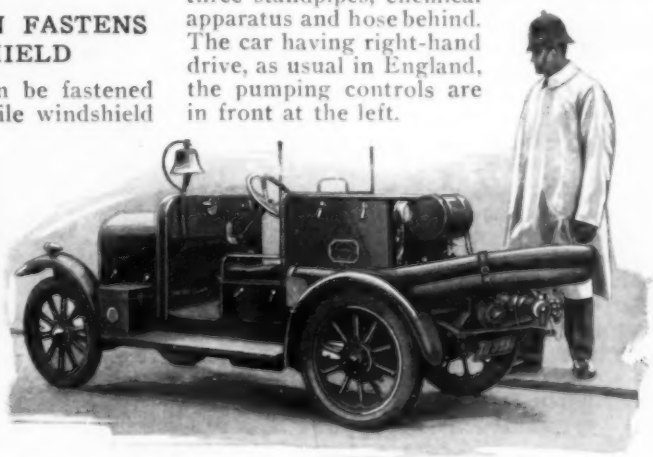
Many of the delights of open-air sports and contests are provided by the indoor pastime of "battle ball," played with toy cannon mounted on a table resembling that used for billiards. Two opposing teams can take part in the game, which consists in shooting small metal balls at a larger sphere of leather in an attempt to force it into goal pits at the ends of the course. Skill is required to aim and "fire" the imitation guns, and the pastime, which is popular in many parts of Europe, is claimed to be excellent training for both the hand and the eye. The apparatus is light in weight and can be readily set up or dismounted in a few minutes. The game has been introduced to American "fans," and its popularity is said to be due to the large number of players able to take part in the sport.

AUTO GLARE SCREEN FASTENS ON THE WINDSHIELD

A glare screen which can be fastened to any part of an automobile windshield in a moment, has no bolts or screws and requires no tools to put it in place. The guard is disk-shaped and filters out the blinding rays from headlights, sunshine and reflected light from the roadway, reducing the risk of accident and making the dimming of signals to oncoming drivers at night, unnecessary. It can be instantaneously removed to any part of the glass panel desired, and either left on permanently or taken off and laid aside, when driving conditions do not require it. Protected by the glare shield, a motorist can be aided by the beams from opposing headlights as they fall in front of his car on dark roads, without experiencing their flash in his eyes. In winter, when frost gathers on the windshield, the use of the glare screen, it is claimed, also permits an unobstructed view through the glass.

ONE-MAN FIRE BRIGADE SERVES OUTLYING DISTRICTS

Almost as completely equipped as a big motor fire engine, but not much larger than a toy, a small automobile outfit that can be operated by one man, serves neighborhoods on the outskirts of London as well as villages and smaller communities. The fuel tank is placed under the instrument board to make room for the pump, three standpipes, chemical apparatus and hose behind. The car having right-hand drive, as usual in England, the pumping controls are in front at the left.



Small Size of Motor Fire Engine Is Illustrated by Human Figure; Its Compactness Aids in Heavy Traffic and Helps Speed

HANDLE FOR SMALL CAMERAS SERVES AS TRIPOD

Holding small cameras steady without the use of a tripod has been simplified by a

Detachable Handle Permits Holding the Camera with One Hand at Level of Eye

wooden handle which is screwed to the underside of the instrument and is held with the left hand while the shutter is pressed with the right. Further stability is gained if the top of the camera is lightly pressed against the operator's forehead. When not in use, the handle may be detached and carried in the pocket or case.

TEN MILLION RADIOS PREDICTED FOR U. S. IN FIVE YEARS

Predicting an expenditure of $450,000,000 for radio by the "fans" of the nation during 1925, experts have estimated that by 1930 there will be 10,000,000 receiving sets in operation in the country. Five years ago, approximately $2,000,000 was spent for apparatus, and last year the amount had increased almost 175 times that figure. In 1923, there were 145,350 sets in use on the farms, and one year later the number had more than doubled. At the beginning of the industry, all apparatus were assembled by the owners, but with the steady development of parts and hookups, the volume of ready-built instruments purchased increased until about forty per cent are now sold ready to tune in. To supply the more than 4,000,000 homes now equipped with receiving apparatus, programs are regularly broadcast from 563 stations established throughout the country.

AUTOMATIC CRANKER ON MOTOR TO PREVENT STALLING

Attachable to any automobile that has a Bendix drive, an automatic cranker starts the engine the moment it stalls and also saves the ignition. It is actuated by magnetic force, throwing the starter into action as soon as the engine stops. In emergencies, such as being stalled on a railroad track, the cranker starts the motor immediately. It may be placed on the instrument board, behind the dash, under the hood with its two small buttons showing on the instrument board, or under the floor. In the latter case, the starter pedal is removed. All that is necessary to start the engine is to turn on the ignition, and as it must be turned off to stop the car, this scarcely will be forgotten.

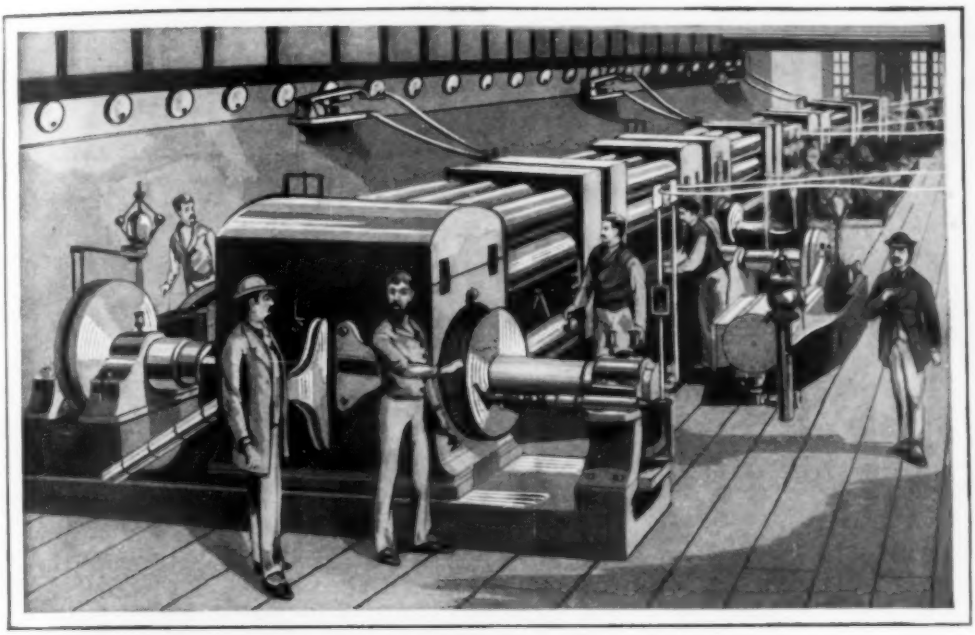
TOY TOWN IS HOME OF LIVE PETS IN CHILDREN'S MUSEUM

In a museum for children maintained in England, a toy village serves as the home for a community of live pets kept as the main feature of the exhibit. Miniature churches and dwellings are set to resemble a town and each building is allotted to a family of small animals. The display is under the care of one man who

Section of Animal Village in Children's Museum Where Live Pets Are Housed in Toy Dwellings

© International Film

designs and constructs the miniature houses. No outward detail is overlooked to make the buildings true copies of those they are patterned after.



The First Central-Power Station Opened in 1882

The Centenary of Electricity

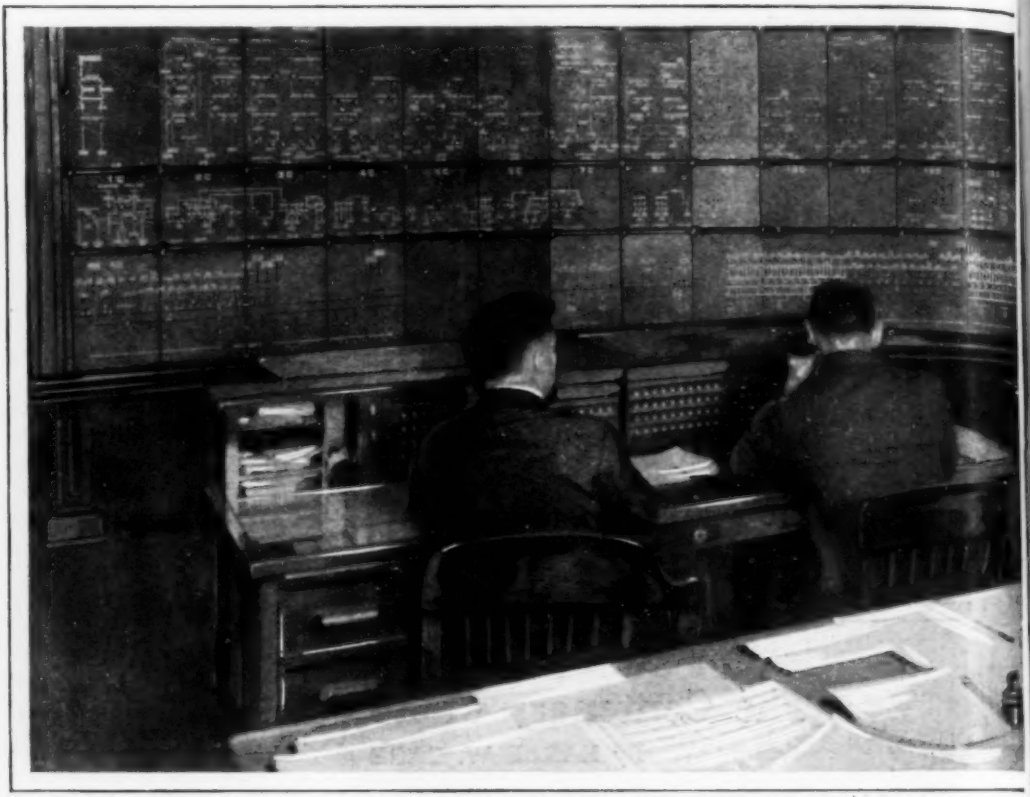
By EARLE W. GAGE

JUST one hundred years ago, Michael Faraday, a young research worker at the Royal Institution in London, made his first effort to produce electricity from a magnet. From this experiment the age of electricity may be said to date. Faraday barely missed success in that first attempt, but continued his efforts until, seven years later, he announced that electricity could be generated by moving a wire in the neighborhood of a magnet.

With the materials he had used in 1824, he made at last a machine embodying the principle of the dynamo. Others followed this up, but it was not until 1871 that the dynamo was made commercially when Gramme applied the ring armature. Then came the epoch-making discovery that the Gramme machine was reversible. In other words, that it would not only produce electricity, but that electricity would produce power. Before Faraday, a trifling incident revealed to an Italian scientist the fact that when two metals and the leg of a frog came into contact, the muscles of the leg contracted. The galvanic battery resulted. Years later another observer discovered that if a wire carrying a current of electricity was wound around a piece of soft iron, the latter became a magnet.

Michael Faraday

Out of these simple discoveries has grown the harnessing of a giant force that illuminates the cities of the world, drives great battleships, melts steel and hauls mile-long freight trains over mountain passes, accomplishing each day in



In the Load Dispatcher's Office Where More than One Million Electric Horsepower Is Directed from Generating Plants to 300 Distributing Centers Supplied by High-Voltage Lines

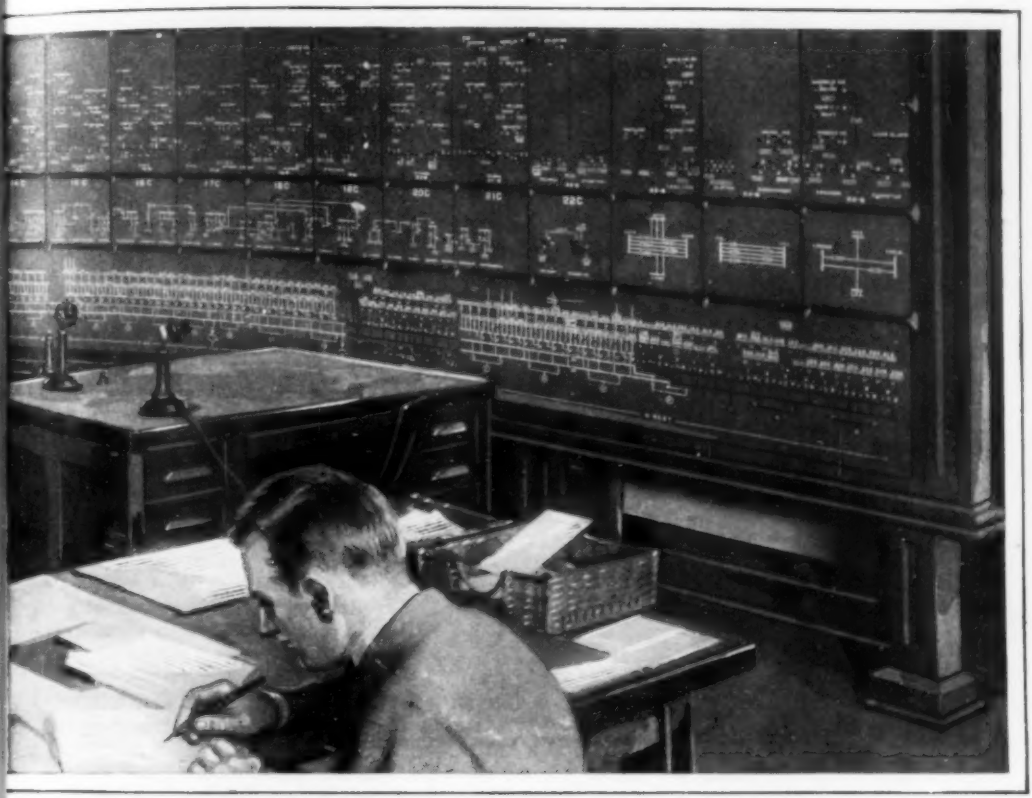
America alone the work of nearly 200,000,000 men.

Only a hundred years ago, Faraday took a magnet and a bit of wire and played with them together, but today the capital invested in electricity in the United States is over $13,000,000,000, and there is only one industry with a larger amount—the railroads. More than this, electricity has changed man's manner of thought. If he would talk to the other side of the world —or sing to it—he talks at once, waiting for no trade winds. He thinks in terms of the instant. In transportation, illumination and communication electricity has done its chief work, and above all in communication.

This came about because in Faraday's laboratory notebook there is an entry, jotted down as something to do: "Convert magnetism into electricity." He wrote that a year or two before the first experiment in 1824, which was finally crowned with success in 1825. The possibilities of electricity were one of many problems that had interested Faraday from his early days. Even as a lad, apprenticed to a bookbinder, he had spent his pennies on experiments in physics, and in 1812, when he was twenty, he made an electrical machine, following the formulas of the time. What he learned in those early days, and what he came to suspect, went into his final achievements.

Of all the discoveries which have influenced and made possible modern civilization, the two greatest probably are the application of heat and artificial lighting. Think how many of our American institutions owe their existence to the control of light! Imagine the world without any form of light save that provided by nature, and you can see how quickly the veneer of civilization would slip away and we would become little more than savages skulking about in fear and darkness.

But the progress of lighting, like the progress of civilization itself, was a slow and difficult process. After centuries of inadequate artificial illumination, electric lighting, scientifically developed, at last made it possible for us to continue our work and our recreation long after the sun has set; in thousands of night schools



Huge Wall Diagram Gives Chief Dispatcher and Assistants Picture of Transmission Lines over Entire System, Showing Which Are Closed, in Service or Being Repaired

artificial light provides the way for education which would otherwise be denied to many; by control of light the officers of our nation's laws are enabled to see that they are observed and to protect the law-abiding majority from the crimes of the lawless minority.

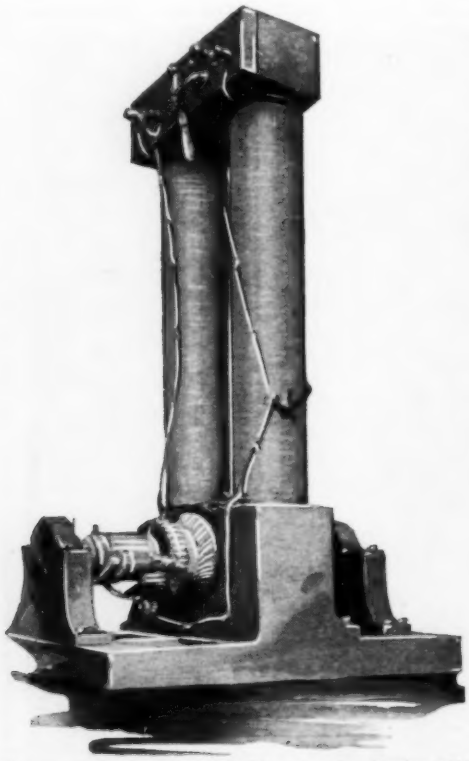
And yet the beginning of the general commercial use of electric light may be said to have been made by Jablochkoff, who, in 1876, lighted several boulevards in Paris with his "electric candle," an arc light consisting of two carbon rods held together side by side but insulated from each other. In this country there were several pioneer arc-light systems, one of the most notable workers in this field being Charles F. Brush.

The extensive use of the arc created a demand for an electric light of smaller size. Several American inventors attacked the problem, among them being Thomas A. Edison, who had a well-equipped laboratory at Menlo Park, N. J., where he had several assistants and many workmen, about a hundred all told. He had made many inventions, among which were the quadruplex telegraph, the carbon telephone transmitter and the phonograph.

Owing to the seeming impracticability of carbon for a light-giving element, he decided to try platinum. Finding that it had to be operated close to its melting temperature, he designed a thermostatic regulator to automatically short-circuit the burner when it became too hot. He found that continued heating and cooling drove gases out of the platinum so that it became extremely hard and could be operated at much higher temperature.

Realizing that the series system of distribution was impractical for household lighting, where each lamp must be independent of every other, he tackled the problem of making a completely new system. He finally evolved a practical multiple system. Reasoning that a high-resistance lamp would be necessary on such a system, he made a platinum lamp having a long coil of fine wire mounted on pipe clay, but this was too expensive to be commercial.

After several trials, he finally mounted

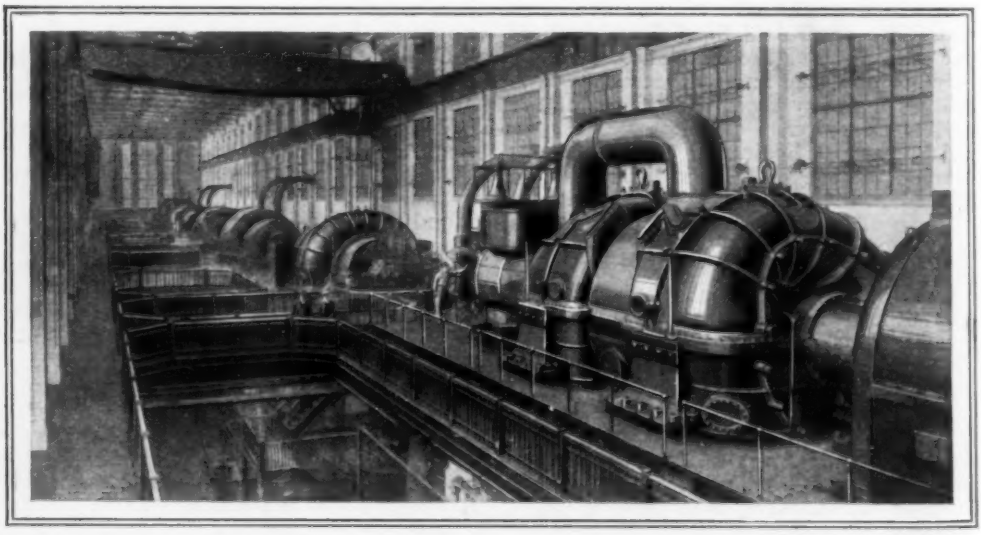


Parent of Later Electrical Marvels, the Quaint Old Edison Dynamo of 1880

a carbonized piece of ordinary sewing thread in his all-glass globe, and turned the current gradually on. This was Oct. 21, 1879, and the lamp burned continuously for about forty-five hours before it failed. He applied for a patent, and on Jan. 25, 1880, a basic incandescent-lamp patent was granted him. All incandescent lamps made today embody the basic features of his patent.

During the next three months, everything conceivable was carbonized to make a better filament, carbonized paper giving results that justified him in announcing his invention. This appeared in a full-page article in the New York Herald of Dec. 21, 1879. A demonstration of his complete lighting system was made at Menlo Park during the Christmas holidays by lighting the grounds and near-by country roads with lamps on poles. The crowds that came out were so great that the Pennsylvania railroad had to run special trains.

Although it was only forty-three years ago that the pioneer electric-lighting company opened for business, today there are fifty-four and more accepted uses for electricity in the home, and upward of 12,000,000 homes wired for electrical service. The electric washing machines in use number more than 3,250,000; the electric cleaners more than 4,000,000. Electric ironers, refrigerators, ranges, cookers, grills, toasters, waffle irons, percolators, sewing machines, flashlights, heating pads, curling irons, vibrators, immersion heaters, utility motors, fans, portable heaters, hair driers, toilet accessories, portable lamps, and so on—these would boost the total to an almost incredible figure.



Courtesy Commonwealth Edison Co.

Where a Quarter of a Million Horsepower Is Generated, inside a Large Central Station with a 50,000-Horsepower Horizontal Turbo-Generator in Foreground and Five Smaller Ones Behind

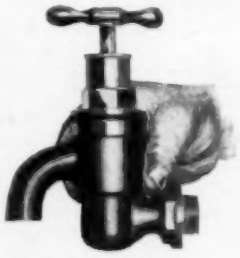
HOW MANY LEAVES HAS A TREE?

In connection with his study of forests, an eastern engineer has counted the leaves on different kinds of trees at various ages and sizes. He discovered that in the late summer, trees that shed according to season have from 3,000 to 30,000 leaves when they are fifty years old, forty feet high and about six inches in diameter. Beech, elm, basswood, ash and hickory had the largest number of leaves; poplar, soft maple and chestnut the smallest. Similar varieties from five to eleven years old bore from less than a hundred to nearly 1,000 leaves a piece. A white pine tree, 18 years old and two inches in diameter, had approximately 500 fronds, while one forty-seven years old and eight inches through bore nearly 6,000. A peculiar feature of this unusual census was that many of the numbers were ascertained by actual count.

Radio Sending Set for Airplanes Is Easily Carried and Will Get Power from Wind-Driven Generator

WASHERLESS AND DRIP-PROOF FAUCET IS EASILY CLEANED

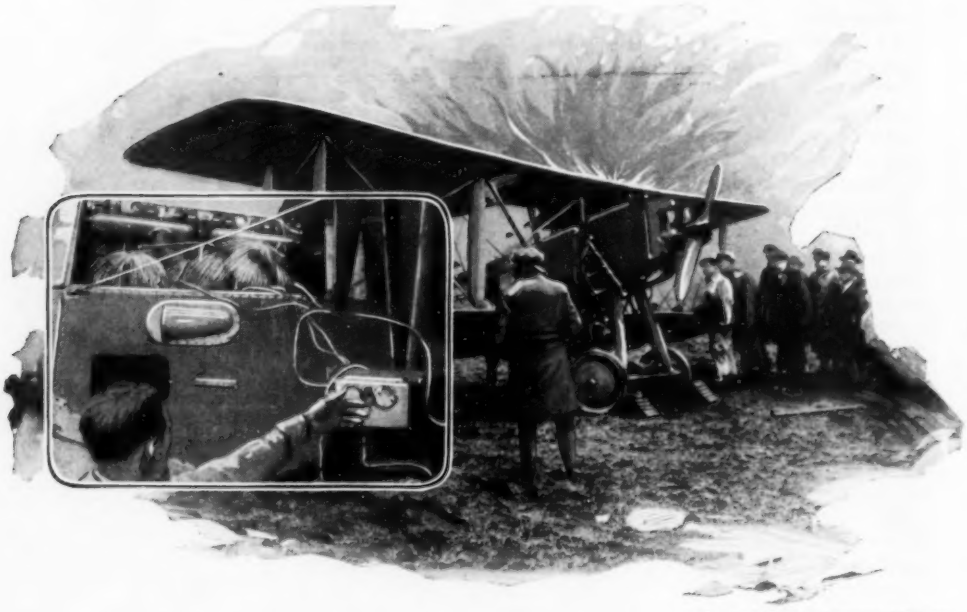
To prevent waste of water, a drip-proof faucet which requires no washers has been devised by an English inventor. The tap, which, it is said, can be easily removed and cleaned in a few minutes, is sanitary and constructed to avoid splashing. Since washers are unnecessary, there is hardly any need for repairs as the faucet is designed to last for a considerable time. It emits a smooth-running stream, and attachments and shields for reducing the splash are, therefore, not required. When installed on a metered line, the tap will accomplish a great saving by preventing leakage, which represents large losses in measured water systems.



TWO-FOOT RADIO TRANSMITTER WEIGHS BUT FIFTY POUNDS

Light weight and compactness are essential features of an experimental radio transmitter the United States navy has devised for use in aircraft. Tests thus far, at the naval base at Quantico, Va., have been made only on the ground, but messages from the set have been picked up on the island of Guam, a mid-Pacific naval station 10,000 miles west and 15,000 miles east of Quantico. It is practically certain that the message traveled eastward, because it was sent when there was more darkness east than west, and it is a known fact that radio waves travel better at night than in sunlight. The set, without the power plant, weighs approximately fifty pounds and is less than two feet in any dimension. It uses two fifty-watt tubes on a high-frequency wave length varying from sixty to ninety meters. This is considered another desirable feature, as it does not conflict with the many commercial radiophone stations using 350 to 600 meters. Only a small power input is required, and officials believe that a thirty-pound wind-driven generator attached to the plane could supply it.

AUTOMATIC FIRE EXTINGUISHER TO SAVE FLYERS



Courtesy Societe Anonyme Minimax

Testing the Automatic Extinguisher at an Actual Airplane Fire; Inset Shows Hand Controls and How Jets of Liquid Are Sprayed into Motor from Nozzles

Sitting aloft in his cockpit, closely scanning the airways and watchful of his ship, a pilot is in grave danger when fire suddenly attacks his motor. He cannot stop to put it out. He quickly must find a safe landing place. In a few seconds, the fire may be beyond control. After ten years' research, a French inventor whose imagination was quickened by this peril, has devised an automatic extinguisher with which, it is claimed, fires can be put out in less than a minute whether the plane is in the air or on the ground.

It consists of four tubular boilers similar to those of a railroad locomotive and, like the steam engine, uses the force of expansion to do its work. These tubes are connected with a piston made of expanding rings comparable to those of a barometer. Perhaps the plane may be sailing smoothly along and fire suddenly bursts out of the motor without the pilot's knowledge. Almost immediately, the added heat causes a liquid inside the boiler tubes to turn to vapor. The pressure thrusts the piston forward and lifts a lever which releases a spring and opens a stop cock. Compressed air or carbonic-acid gas rushes from the outlet into a pump of another reservoir containing a powerful fire-extinguishing liquid. In a second or two, jets of this substance are shot into the heart of the flames from the little pump. While this has been happening, the magnetos of the motor have been shut off automatically, the gas supply stopped and shutters of the radiators closed to keep air from the flames. Under actual tests, the apparatus is said to have extinguished a number of motor fires in from three to ten seconds. It can be operated by hand if necessary simply by pressing a switch. A few pints of the extinguishing liquid are sufficient for a violent blaze, and the reservoir that supplies the jets may be recharged simply by turning another switch.

ESPERANTO TAUGHT BY RADIO

Advocates of Esperanto as a universal language are broadcasting lessons in the subject from a Paris wireless station. The lectures are designed to give the listeners a fair working knowledge of the language and to prove its practical value. Radio, it is believed, is an effective object lesson in the limitations resulting from a wide diversity of tongues, for many programs cannot be enjoyed in Europe although sets receive them distinctly, because the entertainers cannot be understood. A prize is offered to the student who shows the greatest progress in studying Esperanto by the radio method.

MAKING CAR RIDE SMOOTHER BY RAIL-JOINT TESTS

To reproduce the pounding effect of a heavy electric car or locomotive, the bureau of standards uses a 400-pound hammer in making tests on welded rail joints. It is raised six inches above the track and then allowed to fall. Another instrument used is a telemeter, an electric device that is clamped to the joint and automatically registers stresses that are placed upon them. This little gauge has shown that a stress of 2,000 pounds per square inch on a clear rail, may be increased to 5,000 pounds if a pebble is put on the track and cars run over it. The tests are being made to improve existing types of welded rail joints, an improvement looking toward smoother riding.

ONE-CYLINDER MOTOR PLOW REPLACES FOUR HORSES

The horse, rapidly being displaced in cities and on farms by automobiles and tractors, has a powerful rival in a one-cylinder motor plow, said to do the work of four of the animal toilers at half the cost. The implement, introduced on an English farm, is readily handled by one man, and owing to its compact construction, can be driven into corners and close to fences generally inaccessible to horse-drawn tools, resulting in increased planting space and a saving of hand work to turn the soil. It requires little attention for upkeep and consumes a small supply of fuel, besides relieving farm hands of the constant care required by draft animals.

Power Plow Driven by One-Cylinder Engine with Which One Man Can Accomplish Work Equal to That of Four Horses

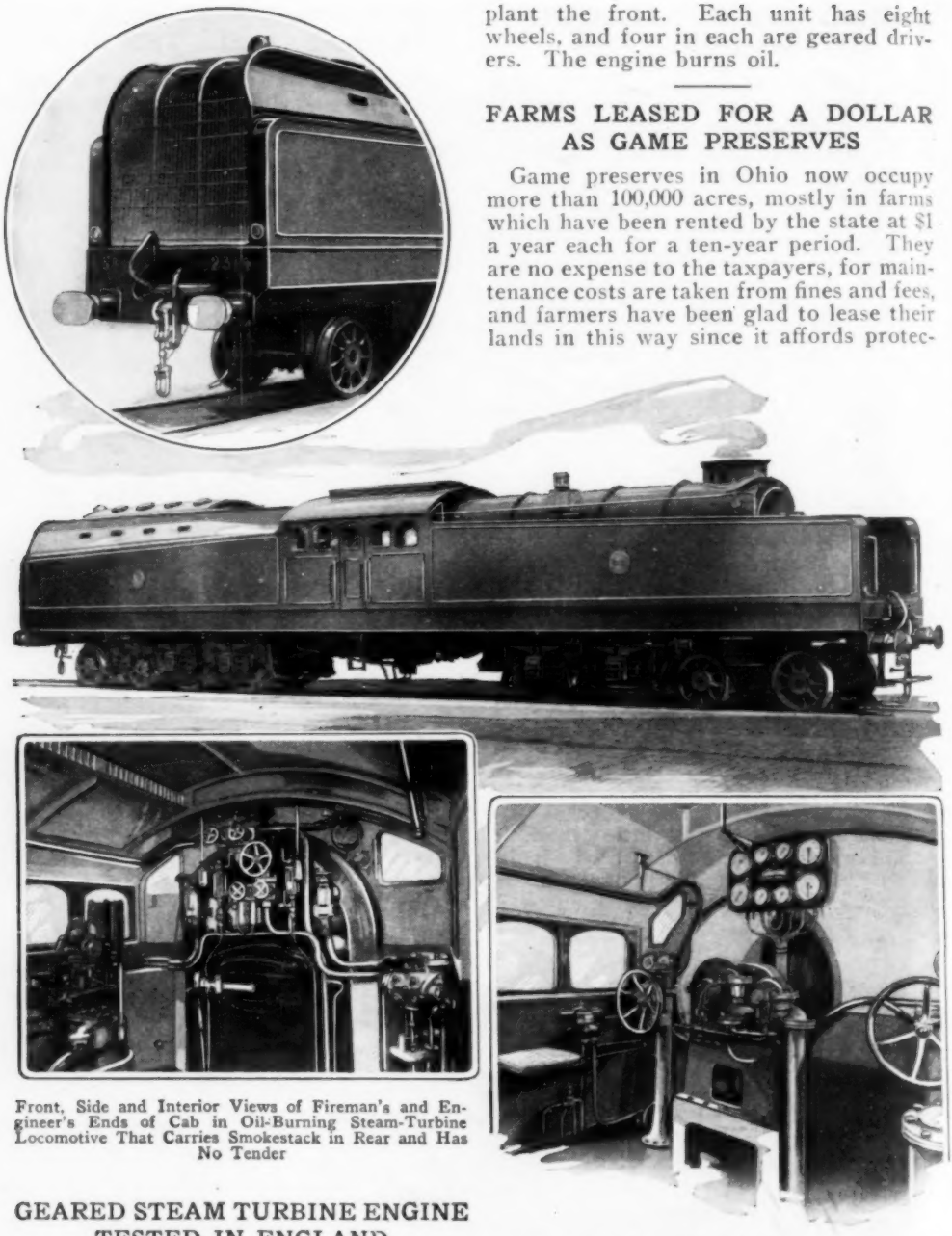
CHARACTER IS READ BY MIRROR THAT ANALYZES THE FACE

Human nature is reduced to the basis of calipers and slide rule by an invention

Analyzing Character of a Subject with a Mirror That "Reads" the Features of the Face

now being demonstrated. The device consists of a mirror made up of a large number of sections, forming a circular looking glass about three inches in diameter, and set in the center of a disk some twelve inches across. Each of the segments of the mirror extends on a curve, all moving together or apart, like the "leaves" of a camera shutter. The segments are labeled with the various facial characteristics and the person having his character read sits sideways to the mirror, so that the profile is clearly shown. Then the operator, with this mirrored face in front of him, moves the outer segments to conform to the description of the face as he sees it. The lines from the segments in the disk lead to letters and figures in the rim. These letters and figures refer to a key book, in which each characteristic is listed.

¶The coast of southern Greenland is receding from Scotland sixty to 125 feet a year, and Iceland is drawing away from Norway sixty to sixty-three feet annually.



Front, Side and Interior Views of Fireman's and Engineer's Ends of Cab in Oil-Burning Steam-Turbine Locomotive That Carries Smokestack in Rear and Has No Tender

GEARED STEAM TURBINE ENGINE TESTED IN ENGLAND

Radical departures from usual types of locomotives were made in a geared turbine engine for an English railroad. It has no tender, the smokestack is in the rear, and fireman and engineer use opposite ends of the big cab compartment, which is in the center. The boiler occupies the trailing end and the condensing plant the front. Each unit has eight wheels, and four in each are geared drivers. The engine burns oil.

FARMS LEASED FOR A DOLLAR AS GAME PRESERVES

Game preserves in Ohio now occupy more than 100,000 acres, mostly in farms which have been rented by the state at $1 a year each for a ten-year period. They are no expense to the taxpayers, for maintenance costs are taken from fines and fees, and farmers have been glad to lease their lands in this way since it affords protection against trespassing and does not interfere with use of the ground. There are eighty-seven such refuges, ranging from 500 to 2,800 acres each and located in seventy-four of the eighty-eight counties in the state. All are placarded and patrolled by sixty-five regular game protectors, supplemented by assistants at special seasons.

AUTOS REFINED BY RESEARCH TO STOP WEAR AND NOISE

Behind the scenes of the automobile industry, armies of men are toiling in secluded laboratories constantly seeking added refinements. Various ways have been found for making an electrical current tell the story of a motor's movements. For instance, there is a device that records the instant of changes in pressure in the cylinders of engines during the compression, firing, exhaust and intake strokes of the pistons. Another measures and records the twisting vibrations of the crankshaft and camshaft. The problem of eliminating noise is receiving increased attention. Instruments that convert sound waves into electrical impulses or that make photographic records of the waves are employed in search for the sources of noise. Engineers found that by cutting a particular gear wheel in two, putting a strip of oil paper between the halves and fitting the two parts together again, they had deadened the ringing sound of the metal; baffle plates arranged over a rapidly revolving shaft stopped the whistle made by the air. Growls, rumbles and hum of gears, fan, bearings and other parts are measured by an instrument that creates a counternoise to drown the noise in the car. Changes in the future, it is believed, will be in the way of refinements rather than anything revolutionary.

LETTER FILE FOR HOME KEEPS PAPERS NEAT AND SAFE

A letter file for use in the home provides a place for valuable papers and correspondence which can be readily reached for reference. Besides preventing loss and injury to the matter, the cabinet is claimed to encourage the practice of keeping bills, certificates, and the like, in one receptacle, and to save delay often caused by searching through shelves and drawers for needed papers. The holder has space for 1,500 full-size business letters and when open, it is said, a postal card can be picked from the bottom even if the container is filled to the limit. Hinged sections may be provided with locks, and the surfaces are finished in attractive shades.

MACHINE VENDS LEAD PENCILS STAMPED WITH BUYER'S NAME

Lead pencils at five cents each and stamped with your name are distributed automatically by a vending machine that is operated easily and can be placed wherever such outfits are needed. The prospective buyer, by pressing a system of levers, sets up the type inside that prints his name. This is done in such a way that errors may be corrected before the impression is made, and the entire name is stamped at once. The machine holds 300 pencils, does not easily get out of order and occupies but little space.

Pencil Vender, Showing Coin Slot and Levers That Set Type to Stamp Name

WORKERS REFRESHED BY SALT RESIST HEAT OF MINES

Miners experiencing fatigue while toiling in warm and damp areas of underground mines, may avoid tiredness by drinking a weak solution of salt water at regular intervals during the working day. The remedy, tested by workers in England, is claimed to replace much of the natural mineral of the body lost by constant exercise in humid air. Another valuable use for salt is said to be its employment as a carrier for a minute quantity of iodine introduced in foodstuffs. Because of the absence of this chemical in products grown in regions remote from the sea, goiter is often found to be prevalent in such communities. The iodized salt permits the drug to be administered as a table article to supply the required element without altering the color or the taste of the salt. Taken for a considerable period, it is believed to be generally beneficial.

Time and Money-Saving Tools

Chain-Swing Seat with Strap for Back Makes Window Washing Safe and Comfortable

Opening Bottles Is Just One of the Many Uses of This Metal Kitchen Spoon, Eleven Inches Long, for Stirring, Beating and Straining

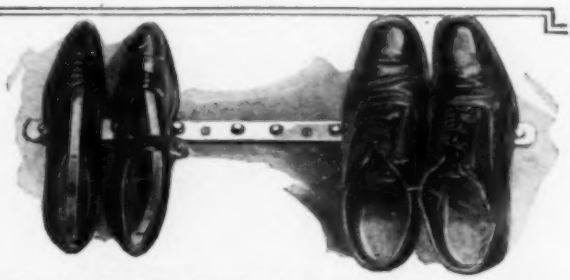
To Keep the Handle from Getting Sticky, a Hook on the Underside Holds the Jam Spoon on the Edge of the Glass

Wherever There's a Light Socket, Meals Can Be Prepared in Electric Fireless Cooker That Is Carried as a Pail, Weighs But Fifteen Pounds, Occupies Small Space and Uses Little Current

Pushcart Market Basket Lightens Shopper's Homeward Journey; If the Load Is Small, Wheels and Handles Can Be Pushed Out of the Way and Basket Carried by Handle on Top

Anyone wishing further information on devices described in the editorial pages can

for Woman's Workshop in Home



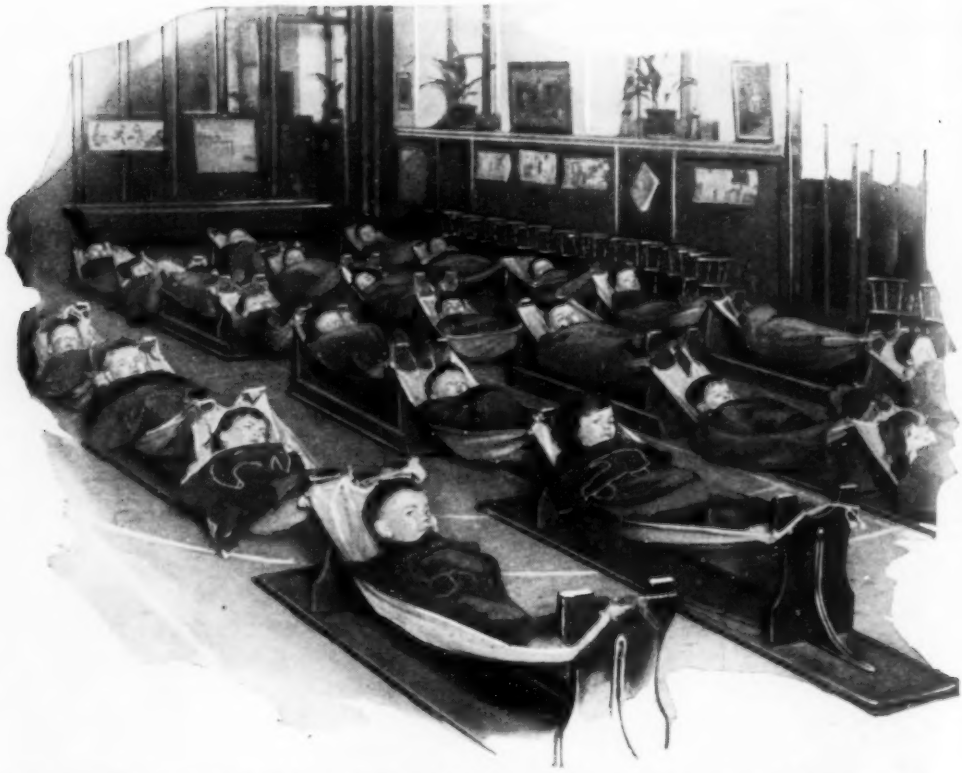
Rack Holds Shoes by Their Soles to Protect the Door, and Buttons Are Spaced for Different Sizes; at Right Is a Night Light That Fits the Ordinary Socket and Is Serviceable in the Nursery or Sick Room

Just Pull a Clamp and Tin Springs Off the Cake, Saving the Bother of Using a Knife

Right, Demonstrating Hair Curler with Spring Lock to Hold It; Below, Revolving Aluminum Laundry Tub with Three Trays and Rotating Center Faucet for Filling Any Compartment with Hot or Cold Water

Lightweight Portable Water Softener for Home Use; Fits Any Faucet and Contains No Chemicals

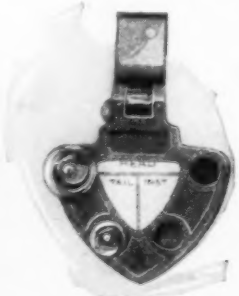
obtain it by addressing Bureau of Information, Popular Mechanics Magazine, Chicago.



Kindergarten Tots of a School in England Snugly Reclining in Hammocks, Slung on the Legs of Inverted Classroom Benches, during the Daily Period of Rest from Play and Study

HOLDER FOR AUTO-LIGHT BULBS FOLDS OUT OF WAY

Spare bulbs for automobile lamps are conveniently carried in a holder which protects them from injury and keeps them within easy reach of the driver. The container is made for attachment to the bottom of the instrument board, and when not required, may be folded out of the way under the panel. Four sockets are provided, each labeled so that the motorist cannot mistake the wrong bulb when replacing a burned-out light. The bracket, which can be easily fastened in position, occupies but little space, and when swung back, leaves no sharp edges to catch clothing or interfere with the operation of the other fixtures.



HAMMOCK BEDS FOR STUDENTS SWUNG FROM BENCHES

Benches are turned upside down and their legs used to support tiny hammocks in which kindergarten pupils of a school in England recline during their daily rest hour. The inverted seats are laid in rows, and the swinging beds swung onto the ends of the wooden legs with a few loops of the ropes. As the benches are low, the children can easily climb into the hammocks without assistance. Small blankets ornamented with nursery pictures are furnished as coverings for the youngsters during the rest period.

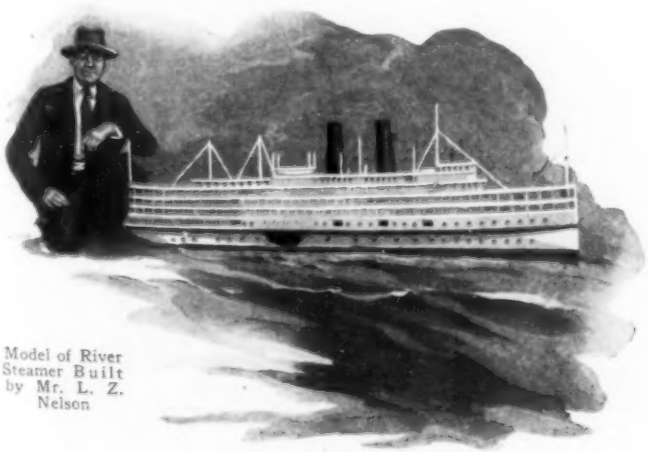
INVISIBLE LIGHT FOR SIGNALS TO FOOL FOES IN AIR

Infra-red rays, the long light waves that ordinarily produce no color sensation on the eye, can be adapted to army use in sending secret signals and for detection of chemical frauds and forgeries, according to Dr. Robert W. Wood, of Johns Hop-

kins university. Only observers equipped with field glasses that had special screens, similar to that used in the transmitting lamp, would be able to see the flashes from the rays, he declares, and a code could be sent in this manner for a distance of five to eight miles in full sunlight. It has also been found that the rays cause a marked change in the appearance of objects. Airplanes, for instance, might be painted with enemy insignia and used for scouting duty with greater safety, as friendly troops, equipped with the special binoculars, would recognize the true signs. Near infra-red rays have actually been employed to effect changes in stage settings. A drop, for instance, that under ordinary light may be made to represent a summer scene, will change to one resembling winter under illumination of the near infra-red rays.

MODELS OF RIVER STEAMERS BUILT BY CLERK AS HOBBY

Building models of Hudson river steamers is the hobby of the clerk of a New York town. He and a companion have made five, using pine boards as their principal material. Their only tools were a saw, plane, chisel, drill and knife. The model of the "Berkshire" shown in the illustration, is seventy-six inches long, twelve inches wide, weighs about fifty pounds and is electrically lighted from the house circuit. Joining the many small pieces, boring the portholes and fitting the tiny plates around them proved a difficult task for amateurs, but the model was pronounced correct in every detail by experienced river men. The builders toiled fourteen hours a day for fifty days to finish it.



Model of River Steamer Built by Mr. L. Z. Nelson

FLASHLIGHT HAS LAMP ON SIDE AND CLIP FOR BELT

For those who work in dark places and need both hands free, a flashlight has been

Handy Flashlight with Lamp on the Side and Clip for Attaching to Workman's Belt

designed, with the lamp on the side so it can be set on end and the rays cast in any horizontal direction. A strong steel-spring clip is also provided on the case, opposite the lens, for fastening to the belt or clothing, permitting the beam to be directed on any point by twisting the body slightly. The device sheds a brilliant light and is claimed to furnish ample illumination for tasks of linemen and for night repair work on roads, bridges and railroad equipment. As part of a motorist's accessories, it can be used in the garage and on the road as a trouble lamp and to aid in making repairs which require the use of both hands.

¶The Popular Mechanics' Bureau of Information offers its free service to all readers of our magazine. Names and addresses of manufacturers and dealers in articles described, and any other details in our possession, will be promptly furnished by addressing the Bureau.

PRINTING PRESS FOR THE HOME CAN BE RUN WITH ONE HAND

Menu cards, programs and small signs can be printed easily and quickly at home on a little press an English firm is distributing. A single movement with one hand runs the roller over the type for inking it and makes the impression. A lever arrangement simplifies the operation and regulates the pressure. Its few parts are of such simple construction that they are not likely to get broken, and when not needed, the outfit may be stored away in a small space.

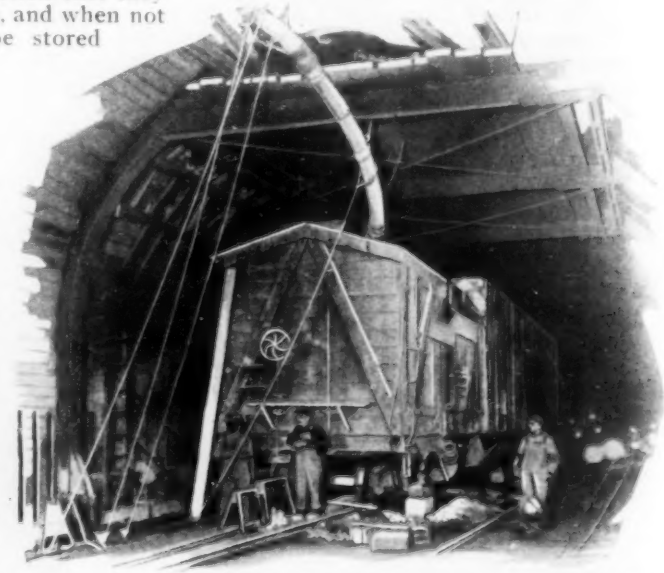
Home Printing Press in Operation; Pressing the Type Block Down with Lever

OLD AUTO OIL IS RECLAIMED

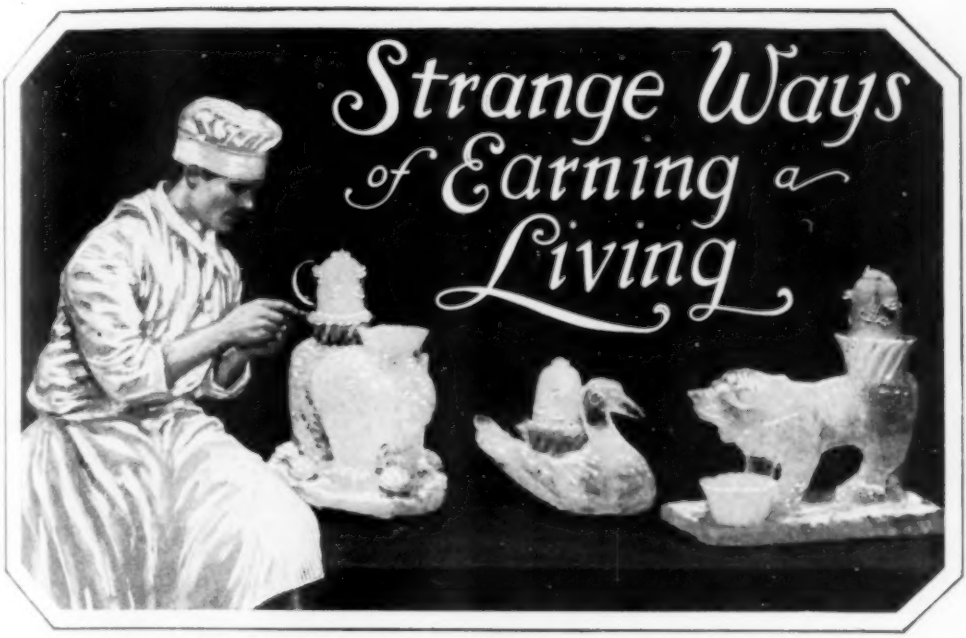
For the economical operation of fleets of motor trucks and automobiles, an electric apparatus has been invented which reclaims the crankcase oil and makes the lubricant suitable for repeated use. The device automatically removes the products of combustion and wear, cleans out the road dust and fuel mixtures and restores the oil to its original lubricating properties. The reclaimer, which operates unattended, can be altered to increase or lower its capacity as desired. It is claimed that the reclaimed oil may possess even greater stability than when originally put in the crankcase, due to the breaking down of less firm elements during its first use, which are removed by the process. One supply of the reclaimed oil is said to have been used for three years, performing for operations totaling 16,000 miles. Even after several redeeming features, it is stated, the lubricant may be used with results equaling new oil, and, as a consequence, may only require slight additions of fresh fluid to replace that part of it which is actually consumed.

HALF MILLION BAGS OF CEMENT USED IN LINING TUNNEL

The task of lining the Connaught railroad tunnel in Canada, the largest tube of its kind in North America, required a half million bags of cement and untold tons of sand and stone to mix the concrete with which the work was done. The material was prepared on the scene in large cars, and compressed air was used to blow it into place behind the wooden forms. Four years were required to complete the undertaking, which is said to be among the largest of its class ever attempted. Due to the double-track system in the tunnel, traffic could continue without interruption during the progress of the work. No loss of life occurred in the accomplishment of the feat.



Lining the Connaught Railroad Tunnel with Concrete Mixed on the Scene in Cars and Forced behind the Forms with Compressed Air



Ice Carver Adding the Finishing Touches to Frozen Sculpture He Models as Containers for Cooling Dainties Which the Frosty Cups Make More Attractive to the Tastes of Diners

By UTHAI VINCENT WILCOX

THERE are tasters of tea and samplers of coffee and there is now a smeller of hams. No, he doesn't work in a grocery store but in one of the world's largest packing houses. This man stabs every cured ham with a pick which he then passes under his nose and is able to state positively and quickly whether that particular ham has soured around the bone or not in the process of curing. That's his job. Quantity production of hams has made this vocation necessary.

But speaking of strange professions, or jobs, or whatever you want to call them, one of the strangest is that of a man who pursues the not unlucrative calling of language teacher to parrots. This teacher of birds is versatile, knowing something of many tongues. He will teach any parrot almost any language according to the place and market where it is to be sold. This parrot tutor has a strange house given over to the "school." The rooms are divided with soundproof partitions, which make little compartments where a "pupil" is hung in his cage. Here the teacher takes the uneducated bird and by a system that he himself has worked out teaches the parrot to say short sentences. Lessons are heard morning, noon and night. Over and over, each day, the teacher will pronounce the same word or even short sentences, depending upon what it is that he is attempting to teach. He says that his pupils, unless they are exceptionally dull or very brilliant, take just bout a fortnight to graduate.

Men, however, have no monopoly of strange occupations, as in Brooklyn, the Society for the Prevention of Cruelty to Animals has installed women on its wagons. Experience has proved that dog owners are loathe to relinquish their pets unless satisfied that the animals will receive the same gentle care that they have at home. On her first day on the job, one of the women brought in sixty-eight dogs and cats, something of a record.

Nature isn't perfect by any means, so there is a chance for man to make a living perfecting the voices of canary birds. It is being done. There is a big German in one of the eastern cities who will take a poor and indifferent canary bird and teach it to trill and warble and do a few roulades. "How do you teach a canary to sing?" he was asked. The old German smiled rather slyly—there were a few secrets to the business, but he didn't seem to be in the mood to reveal them. When he was pressed more insistently to tell how the birds were taught, he admitted: "A cricket is sometimes an excellent teacher, though his instruction periods are

Teaching Young Canaries to Sing, with a Tiny Piano for Accompaniment

Clothed like a Native, This Scientist Hunts Insects in the South Sea Islands

Lady Custodian of Hundreds of Rats and Mice Used in a Research Laboratory for Medical Studies

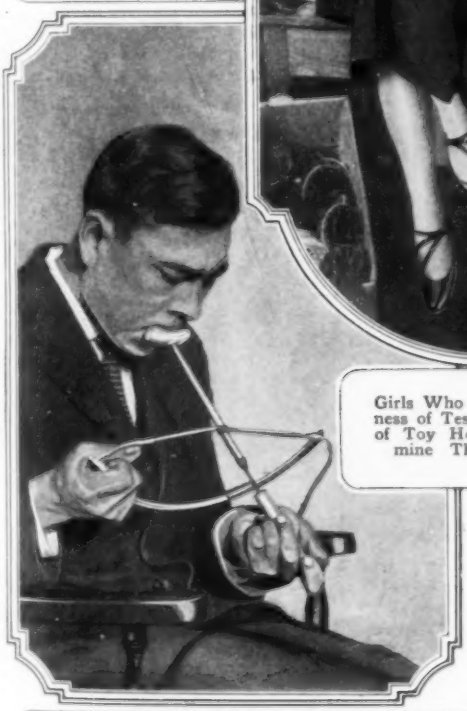
Mender of Oriental Curios Repairing a Damaged Oddity That Was Made More than 800 Years Ago; Right, Expert Preparing to Make X-Ray Pictures of a Swiss Cheese to Learn Quality

Right Photo © U. & U.

Animal Ambulance in Charge of Women Specializing in Care of Ailing Pets

To "Paint" Pictures in Colored Rope Is This Artist's Novel Craft

Girls Who Make a Business of Testing the Notes of Toy Horns to Determine Their Volume



Employing the Eskimo Method of Cutting Beads from Ivory with a Crude Brace and Drill; Right, Wax Imitations of Fruit Copied by an Artist for the Agricultural Bureau

Right Photo © U. & U.

a bit uncertain. On the whole, though, other birds with good songs are the best teachers."

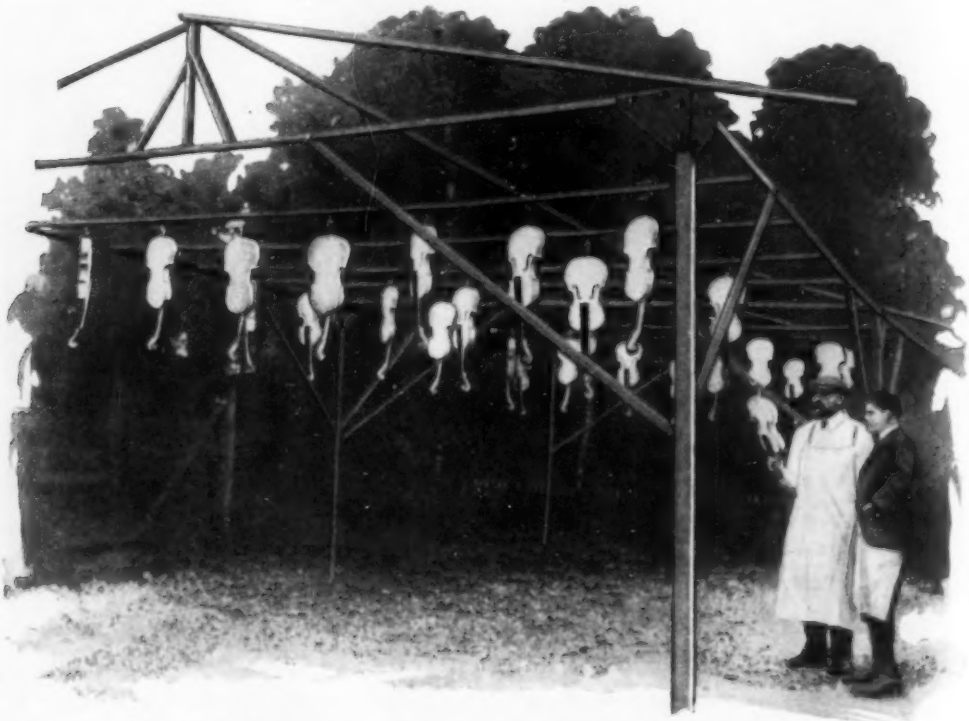
Most of the strange occupations in the world today are the result of civilization and its strange demands. Because men, but probably women mostly, like pearls, there has come to be the pearl expert. There is one man in New York who qualifies for the head of this one-man business. His equipment is a square of black velvet and a microscope, and the ability to keep his specialized knowledge secret. This man is retained on a yearly basis by the great gem houses of the city who employ him not only to appraise the pearls that they buy but the pearls owned by estates that are occasionally broken up. One reason why this one-man business is a success is that he can be trusted not to tell if he finds that the gems of some dominating society matron turn out to be fish scales and not pearls.

But for gainful occupations you should make the acquaintance of "Cinder Ella," the old crone who haunts Wall street, or did until a short time ago. She may be there as usual, with business as usual, next summer for all the curb brokers may know. Her name tells her occupation—she picks the cinders out of the eyes of the curb brokers and receives therefor whatever they may give her.

If you go down in the Chinese quarter of your city to get your toothpicks you may be able to get the kind that you can chew up but not down. If you succeed in finding this variety, it is because of the business of a man of Seattle who makes regular trips to Bering Straits where among the Indians he buys walrus mustaches. These long, black, stiff hairs are taken back to Seattle and sold to the Chinese who consider them very choice and the politest of toothpicks.

But there are still more: Have you heard of the school for the teaching of men and women to pose as wax models in exclusive department stores? There is one. Have you heard of the man in Maine who makes a very comfortable living catching hedgehogs? He ships them to many parts of the world.

These are but a few of the occupations that have arisen from modern hectic life. The census bureau says that there are some ten thousand occupations that men and women follow in the world, but we wonder if they know about them all—these for instance.



Instructor and Student at a School That Teaches the Art of Violin Making Examining Instruments Hung Out to Dry after Being Coated with a Covering of Shellac

COLOR TESTER FOR FABRICS DETERMINES DURABILITY

Uncertainty as to whether colored fabrics will fade or not is greatly reduced by a testing apparatus that adapts to another practical use one of the latest triumphs of science, clear fused quartz. The outfit consists of a special electric lamp within a six-inch fused tube of the quartz material. Samples of cloth are exposed for a few hours to the brilliant white light and the ultraviolet rays cast by the lamp. They are then examined and compared with untested cloth. From the changes in color, it is possible to tell just what effect sunshine under ordinary conditions will have on the goods, as the relative action of the lamp and of normal light has been accurately determined. The chief value of the quartz is that it does not obstruct the rays which affect the pigment. Ordinary glass does. Furthermore, with the lamp a reliable test can be made in a comparatively short time, for exposure to the ultraviolet rays will affect the fabric much quicker than direct sunlight.

RUBBER PADS IN HAMMER HEAD ABSORB SHOCK OF BLOWS

Hammers that are lined with rubber in the opening that fits onto the handle so that the shock of the blows is absorbed, have been placed on the market. Gripping the handle firmly in the socket, the rubber cushion takes up the jar of the blows before it can reach the hand of the person using the tool. Extreme tests are said to have proved the efficiency of the idea.

HOUSE OF CORN IS BUILT FROM SCHOOL CHILDREN'S CROP

Representing thirty-seven kinds of corn in ten different colors, a house in Sidney, Nebr., entirely built from the ears and stalks of the grain raised by school children, formed a popular feature of a harvest exposition. The structure, which was set up in the center of a prominent street, is substantially put together and ornamented in novel designs. The outer walls are composed of ears of the corn, stalks form the thatched roof and the floor is made of kernels. High-school students erected the house, which serves to give the visitor an idea of the kinds and quality of corn the neighboring soils are capable of producing.

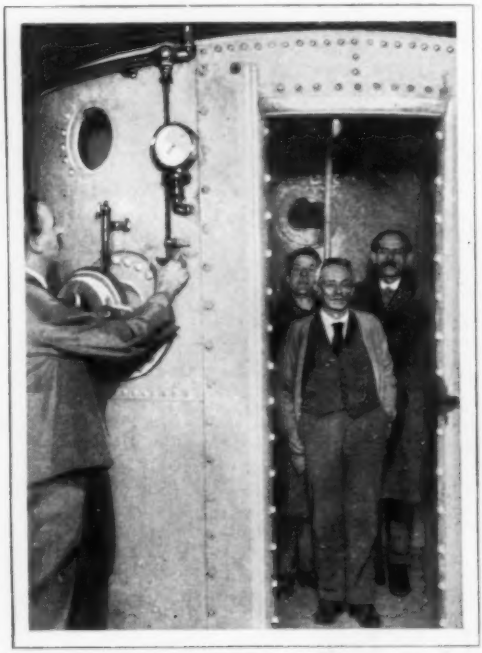
House Built from Corn That Was Raised by School Children; Ears, Stalks and Kernels of Various Colors Were Used to Ornament the Structure

LIGHT PLANT RUNS ITSELF

A hydroelectric light and power station which can start, stop and regulate its output of current in accordance with the demand put upon it, all without the aid of attendants, is in service on the Deerfield river in Vermont. The plant can also readjust its operation so that service interrupted by short circuits is resumed automatically. When in working order only an occasional inspection is required.

STEEL "LUNG" TO CURE ILLS BY COMPRESSED AIR

Sufferers from bronchial troubles at a London hospital are placed in a large steel cylinder and subjected to compressed-air



Patients Awaiting Compressed-Air Treatment in Steel "Lung"; Operator at Outside Controls

treatment. The receptacle is ten feet high, more than six feet in diameter, contains seats and a table and will hold several persons at a time. Air pressure is regulated by outside controls and is shown on a gauge. It is raised to the maximum at the end of the first half hour, maintained at this point for an hour longer and then gradually reduced.

NAMES FOR FREIGHT TRAINS TO REPLACE NUMBERS

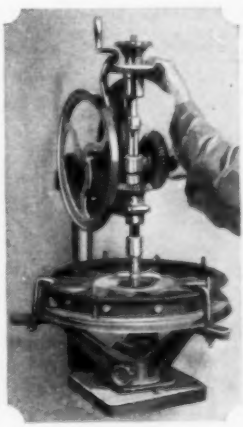
Names that typify speed and certainty and that express the character of the service, are to be given fast freight trains on an eastern line in place of prosaic numbers. "Ironmaster" is the title selected for a train that carries steel from Pittsburgh to New York, the "Eagle," the "Meteor," the "Blue Streak" and the "Blue Goose" will describe other freights that operate on fast schedules. "Gas Wagon" has been chosen to designate an automobile train and "Spark Plug" is to haul perishable goods.

SUN'S HEAT SOUGHT AS HERALD OF CYCLONES AND DROUGHT

Four years of observations to determine a method of long-range weather forecasting, based on daily measurements of the sun's heat, will be made by a joint expedition from the National Geographic society and the Smithsonian institution. According to scientists, solar energy strikes all parts of the earth's outer atmospheric envelope in equal volume, but due to interference of dust particles and vapors, is materially affected before it reaches the surface of the earth. To discount such influences on the sun's heat, special instruments and apparatus will be used by the expedition in taking the measurements. Rains, snows and dry spells, it is said, are due to the slight variations of the heat we receive from the sun, and analyses of these differences may serve as a guide to a solution of the weather problems as they affect forecasting a long time in advance of changes. It is hoped a process can be devised whereby cyclones that rage over the plains of the middle west, storms at sea, springtime frosts, and even pleasant weather for outdoor celebrations, may be foretold a considerable period before they take place. Surveys will be made in Asia and Africa for a suitable point at which to establish a field station for the scientific expedition.

WHEELS FITTED TO BALLOON TIRES BY HAND ADAPTER

Old wooden automobile wheels may be quickly changed to suit balloon tires by a hand-operated adapter which performs all necessary work for the alteration. Wheels can be removed from any make or type of passenger car, remodeled to take the large treads, and replaced in a single series of a few short operations. The machine is designed for easy installation and requires but little space against a wall or upright support. Tool parts for the various cutting processes may be quickly changed.



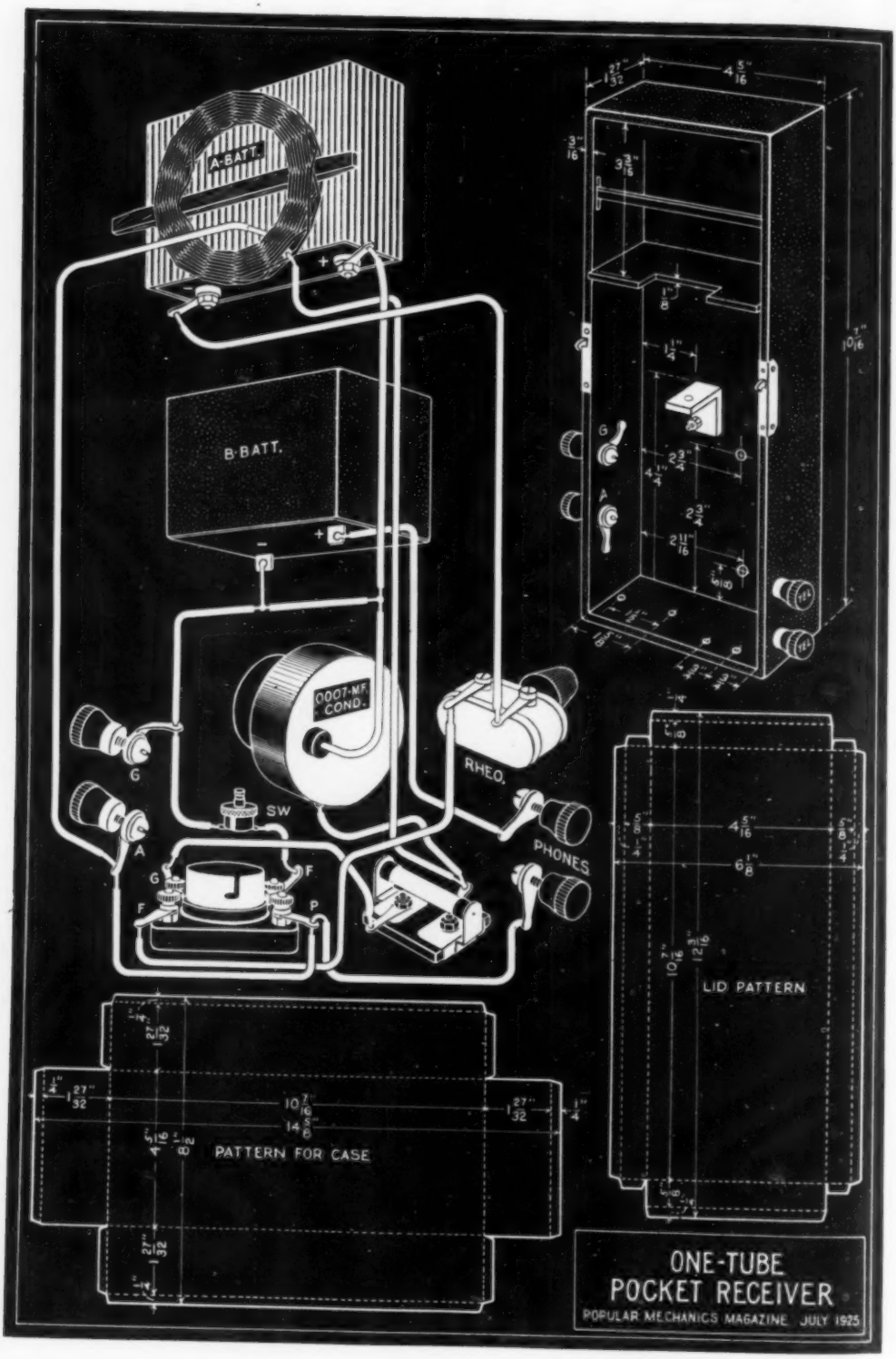
RADIO

Receiving Set for Travelers Fits in Pocket

ALMOST compact and efficient one-tube receiver, so tiny it slips into a pocket with ease, yet big enough to work a loud speaker on local stations or pick up broadcasters 500 miles away under ordinary conditions, is the latest development of the Popular Mechanics radio laboratory.

Designed for the traveling man, or others who want a small, light receiver to carry in a spare corner of the traveling bag, or an overcoat pocket, the little one-tube outfit is an extremely efficient ultra-audion set with a range equal to that of instruments occupying three times the space. A and B-batteries are built into the box, which contains all the instruments, in fact, with the exception of the phones. A single dial is used for tuning, and the only other control is a filament rheostat of the carbon-pile type. Both control knobs and the aerial, ground and phone binding posts are grouped at the top end of the

A One-Tube Regenerative Receiver That Will Fit in the Coat Pocket; Traveling Men Will Find This an Ideal Set


A-BATT.
B-BATT.
.0001-MF. COND.
RHEO.
PHONES
SW
G
A
F
P
PATTERN FOR CASE
LID PATTERN
ONE-TUBE
POCKET RECEIVER
POPULAR MECHANICS MAGAZINE JULY 1925

Left, Tuning the Receiver; Right, Back of Set with Lid Removed to Show Location of Instruments and Batteries

box, so that it may be slipped into the pocket, and even operated in that position. The case, a thin basswood glove box, measures but 2½ by 4⅝6 by 10⅞6 in.

To operate the set, pull out the filament switch, and turn up the rheostat until a hissing noise is noted in the phone, then rotate the condenser dial until the station is picked up; three complete turns of the dial bring the condenser from minimum to maximum. The filament rheostat is adjusted to the proper point for best volume and clarity. The condenser is of necessity the smallest type available having this capacity range, and the small dial used is 2 in. in diameter. A partition of ⅛-in. material, cut from a cigar box, separates the A and B-batteries. A large 4½-volt C-battery is used as an A-battery for lighting the filament of the tube. This battery is placed at the end of the box. The coil consists of 70 turns of No. 24 single silk-covered magnet wire, wound on a form made by inserting 15 small finishing nails into holes drilled around a small spool. The wire is wound under two nails and over two nails, until the required number of turns is obtained. Coat the coil with flexible collodion, before removing the nails from the spool; when the collodion has set, the nails can be withdrawn and the coil will be self-supporting. The case is then notched just above the filament battery, and a thin strip of wood run through the coil; this strip of wood fits in the notches and supports the coil just above the A or filament battery. The B-battery consists of a small 22½-volt unit placed in the position shown in the diagram and photo.

The variable condenser, of the single-hole mounting type, is fastened at the right and directly under the B-battery. The rheostat is mounted in the same way just below the variable condenser, and must be turned so as to allow clearance for the push-pull filament switch. This switch is mounted in the space between the variable condenser, rheostat and the tube. The tube socket is a small type suitable for the UV-199 tube, and is screwed to the end of the case. Mount the grid condenser at the right of the tube socket. The capacity of this grid conden-

Full-size blueprints of this set may be obtained by simply sending 10 cents, to cover the cost of wrapping and mailing. Address the Radio Dept., Popular Mechanics Magazine, 200 E. Ontario St., Chicago, specifying blueprint wanted.

ser is .00025 mfd., and it should be equipped with clips for the grid leak. A 2-meg. leak is used. The circuit is wired with stranded rubber-covered wire, of small diameter.

The case is now ready for the covering, which is thin leatherette or pantasote. Make a pattern of heavy brown paper before attempting to cut the material. All dimensions for both lid and box are given in the blueprint. These dimensions will vary, of course, if the case used is of a different size, and the pattern will have to be cut accordingly. Cut this pattern out, fit it to the box, cut holes for the instrument shafts, and binding posts, and trim to exact size. Now lay the pattern on the back of the material and outline with chalk or colored pencil, cut the material, and glue it to the case with a good grade of liquid glue, smooth out and allow to dry. The nickelplated catches on the lid and box can be obtained from a hardware store or luggage manufacturer. The case and lid are notched for these catches after the covering is on the case, and then they are nailed in place with small brads, obtained from a cigar box. After remounting the binding posts, the condenser dial and rheostat knob, the instrument is ready for operation.

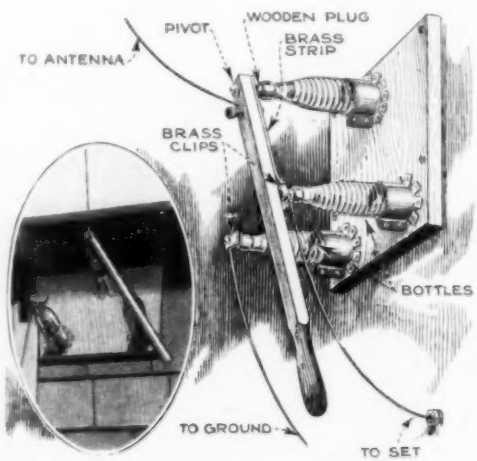
When traveling, a temporary aerial can be used, such as a bed spring or window screen, but for more permanent use, run two or three turns of bell wire behind the picture molding of the room, bringing one end down to the aerial post. For a ground use a near-by water pipe. When used in the open, a wire attached to a rope thrown over the limb of a tree makes a good temporary aerial. The circuit used in this little set is highly regenerative and almost any type of aerial will give results on near-by stations.

MATERIAL LIST

1 socket for UV-199 tube.
1 push-pull filament switch.
1 .00025 dubilier grid condenser with leak clips.
1 grid leak, 2 meg.
1 UV-199 tube.
1 Eveready 22½-volt B-battery, type 763.
1 Burgess 4½-volt C-battery, type 2370.
4 binding posts.
1 Bradleystat.
1 Connecticut variable condenser, panel type J-108.
¼ lb. No. 24 single silk-covered magnet wire.
1 wood glove box.
½ yd. thin leatherette.
1 brass strip 1-16 by ½ by 2½ in.
2 small snap-lock catches.
3 feet small stranded rubber-covered wire.
12 soldering lugs.
Total cost $15.00.

An Efficient Lightning Switch

The lightning switch shown in the illustration is very efficient, and can be made at low cost. Three pop bottles are used. The bottles are mounted in a triangle. The switch arm is wood, and has a flat brass strip mounted on its under surface; this strip is bent so as to engage the clips on the lower insulators. The switch arm is hinged to the top of the upper bottle, by means of a heavy wood screw mounted in a tightly fitting wooden plug driven into the neck of the bottle. The clips on the lower bottles are old switch clips and mounted in the same manner.



An Effective Lightning Switch Made with Pop Bottles; Insert, Switch Mounted on Exterior of Building

The mountings for the bottles can be made from scraps of sheet metal, bent to form collars, the lower edge of the mountings being slit with tinner's shears or a hacksaw to form a base to screw to the board, and the mounting or collar is drawn tightly around the bottle by means of two stove bolts as shown. The aerial wire is connected to the switch arm near the pivot screw. A small brass machine screw is used to obtain a good electrical contact to the metal strip under the wooden arm and the aerial connection should be soldered under this screw. The ground and the lead to the set are connected as shown.

Wood Hinge on Cabinet Aids Efficiency

Stray capacities are detrimental to many sets, and it is to eliminate one cause of stray capacity that a new cabinet has been developed. This, instead of the common metal hinge, has a hinge made of mahogany, the same wood as that used for the body of the cabinet. The effect of the common metal hinge on the circuit, it is said, has been demonstrated in the case of a neutrodyne receiver, which, although perfectly neutralized when out of the cabinet, had to be neutralized again as soon as it was placed in the latter and came within the influence of the long metal hinge.

Battery Has Built-In Visible Hydrometer

The radio beginner's objections to the standard-type storage A-battery, which must be carefully watched to keep the water level correct and the charge up, are removed by a new type of battery with glass shell. The high and low-water level lines are blown in the glass, and the actual level of the liquid is constantly visible. Readings to tell the state of charge are made on a built-in hydrometer in one of the end cells, two small wax balls of different specific gravity being used. When both balls, which are contained in a slot, are at the top of the liquid, the battery is fully charged, and when both are at the bottom, as shown in the picture, the battery is discharged. Because of their different weights one ball drops first, indicating the battery is one-half discharged. The unit has a thirty ampere-hour capacity.

THE 5-TUBE NEUTRODYNE was completely described in our February and March, 1924, numbers. This set will operate a loud speaker on stations up to 1,500 miles, and is very easy to tune and log. These issues may be obtained (25 cents each) from the Circulation Department.

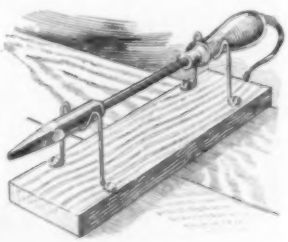
Loud Speaker Made from Paper Cone

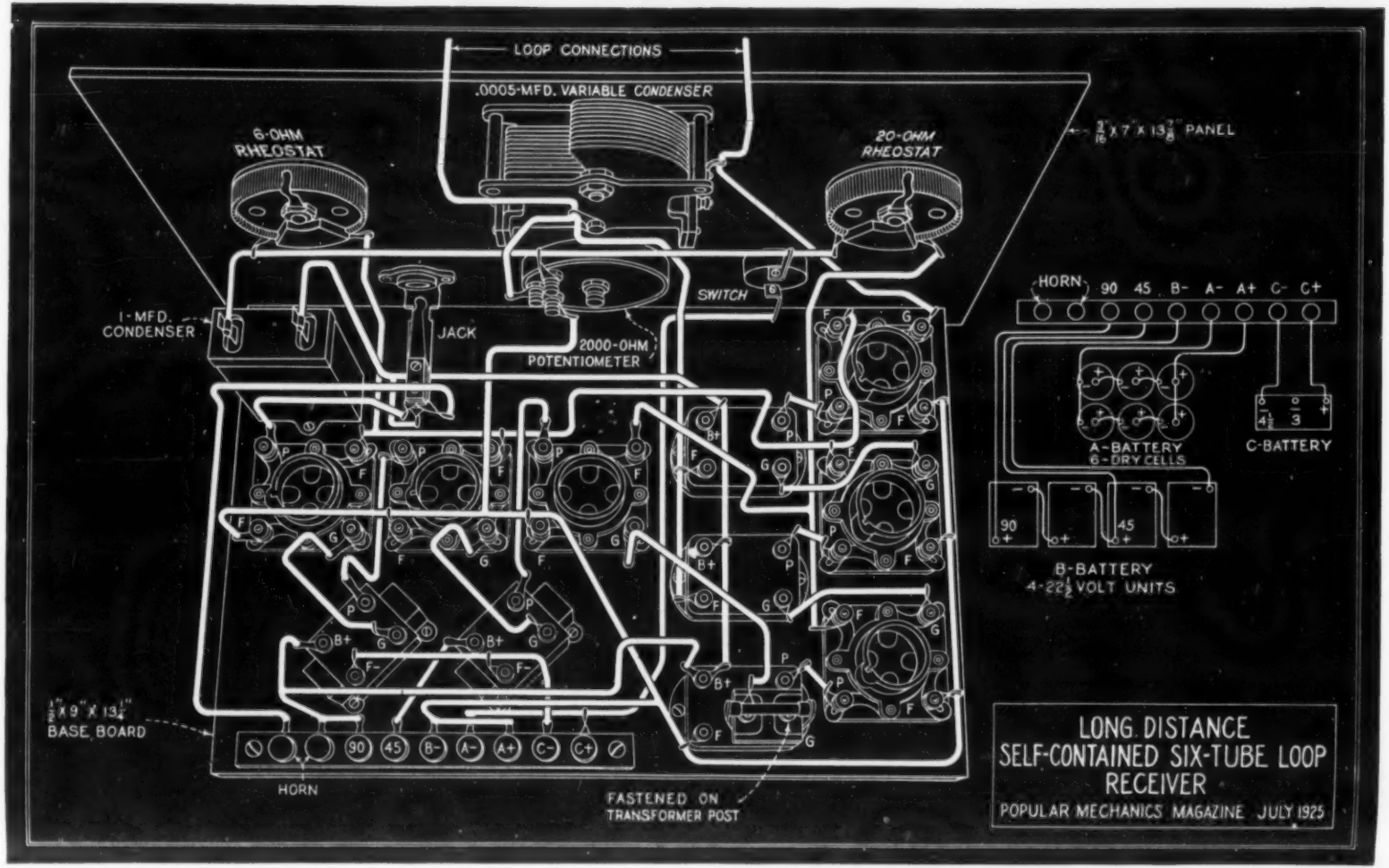
A simple loud speaker, which gives a good tone and volume can be made by anyone from a disk of thin cardboard or stiff paper. The disk is cut radially and the edges of the cut drawn up to form a wide cone. A pin is fastened in the center and soldered to an ordinary headphone diaphragm, as shown. The cone may be pleated as shown in the illustration, but this need not be done unless desired.

Stiff-Paper Cone Makes Loud Speaker of Good Tone and Volume

Easily Made Rest Is Useful in Soldering

The fan who has burned a spot on the top of his table when building the set by absent-mindedly putting down the hot soldering iron on it, appreciates the advantage of some sort of rest for the iron. It is a very simple matter to make a practical rest from a couple of short lengths of left-over busbar wire and a piece of wood. Eyes for screws are bent at the ends of the wires, and the middle parts formed to a V-shape in which the iron rests as shown in the illustration. The supports are fastened to the wood by means of screws driven through the eyes, as indicated.



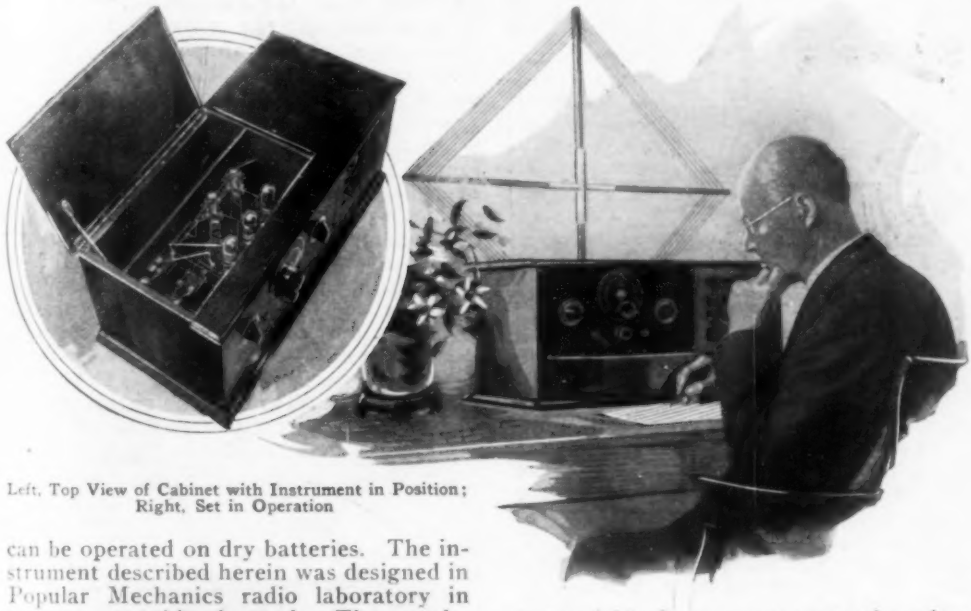

LOOP CONNECTIONS
.0005-MFD. VARIABLE CONDENSER
6-OHM RHEOSTAT
20-OHM RHEOSTAT
3/16 X 7 X 13 7/8" PANEL
1-MFD. CONDENSER
JACK
SWITCH
2000-OHM POTENTIOMETER
HORN 90 45 B- A- A+ C- C+
A-BATTERY 6-DRY CELLS
C-BATTERY
B-BATTERY 4-22½ VOLT UNITS
7/8" X 9" X 13¼" BASE BOARD
HORN
FASTENED ON TRANSFORMER POST
LONG DISTANCE SELF-CONTAINED SIX-TUBE LOOP RECEIVER
POPULAR MECHANICS MAGAZINE JULY 1925

Six-Tube Self-Contained Loop Set Has Coast-to-Coast Range

By F. L. BRITTIN

THERE is a constant demand for a six-tube, self-contained loop receiver, capable of coast-to-coast reception, that can be operated on dry batteries. The instrument described herein was designed in Popular Mechanics radio laboratory in response to this demand. The results have been carefully checked, and we are satisfied that this receiver will meet all the requirements of our most exacting radio friends. In order that it may rightly be called a self-contained receiver, the A and B-batteries, as well as the horn, are incorporated in the cabinet with the instrument. The receiver is designed for loop operation, although it can be used with an outside aerial; best results, however, are obtained with the loop. The instrument tunes more closely on the latter, and interference from other stations and static are minimized. The use of an outside aerial tends to broaden the tuning, and bring in extraneous noises.

Good tone, long distance and selectivity are the outstanding features of this receiver. Twenty-seven stations were logged in one evening from Chicago, with good tone and very satisfactory volume on the loud speaker. These stations included Washington, Pittsburgh, Schenectady, Detroit, Cincinnati, Jefferson City, Fort Worth and Los Angeles, all on the loop. No ground is used. The self-contained feature appeals to the feminine members of the family, because there are no messy storage batteries or trailing wires to be kept in order, and its ready portability permits the operator to move the instrument quickly from one room to the other. The instrument is easy to build, and the cost is about $110, which is not high for a set of this type, including, as it does, tubes, batteries, cabinet with built-in loud speaker, and loop.

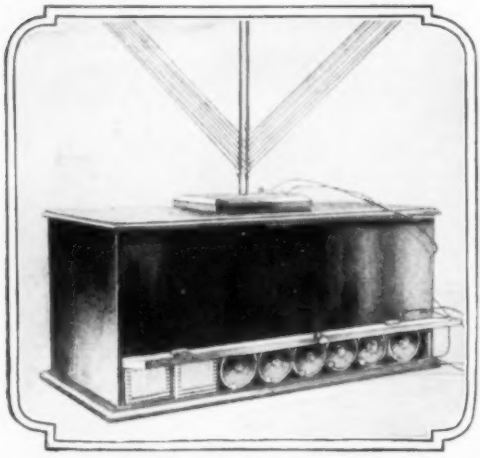


Left, Top View of Cabinet with Instrument in Position; Right, Set in Operation

When in operation, place the loop at least 6 ft. from metal objects, such as steam radiators or heating pipes, which would be likely to absorb a part of the energy that would otherwise go to the loop. In buildings where there is an appreciable amount of steel construction, this becomes a real factor with any loop receiver, and the loop will often lose its directional effect, if the set does not refuse to operate at all on distant stations.

It is best to obtain all the parts before beginning construction. The front-panel and baseboard layouts are very simple and clearly shown in the blueprint diagram. The dimensions of the panel and baseboard will vary, of course, according to the size of the cabinet used. No. 14 tinned-copper busbar is used throughout the circuit. Spaghetti tubing is not necessary unless some of the leads should run so close together that there would be possibility of their touching. Keep all plate

and grid leads well separated and do not parallel them. Where it is necessary to cross these leads, do so at right angles.

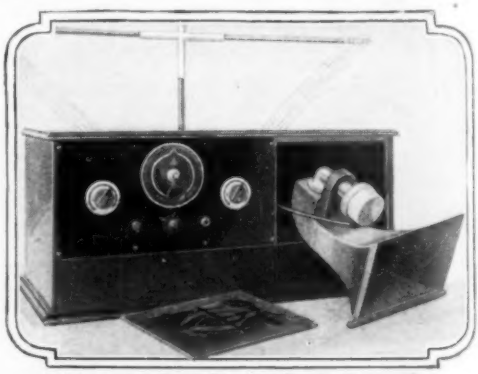


Rear View, Showing Batteries

Use soldering lugs under all binding posts, and use solder and flux sparingly.

The A, B and C-battery connections are shown in the blueprint diagram at the right of the instrument. The A-battery consists of six No. 6 dry cells connected in series-parallel. The A-positive and B-negative terminal posts are connected together at the terminal strip, but the A-negative terminal is not connected to them. The B-battery consists of 22½-volt units connected in series; the C-battery is a 4½-volt unit. Flexible rubber-covered wire is used to connect these batteries to their respective binding posts on the terminal strip. The arrangement of the A, B, and C-batteries in the lower compartment of the cabinet is shown in the rear view of the cabinet. Only two of the B-battery units can be seen, as they are placed one pair behind the other. The reader will note the position of the A-battery cells; the C-battery is placed behind these cells, and does not show in the illustration. The leads are taken up to the binding-post terminal strip through holes in the upper instrument compartment; the flexible leads are taken through holes drilled in the rear of the cabinet. The cabinet is well designed and very compact; it may be built by the reader if desired, but can be obtained from a radio dealer or direct from the manufacturers. The horn is built into the cabinet. This construction is clearly shown in the front view on this page, showing the horn partly pulled out; the grill shown in the illustration is screwed in front of the horn when assembled. The cabinet is 23⅜ in. long, 11¼ in. high and 10⅝ in. deep in over-all dimensions. A wood partition divides the horn compartment from the instrument.

The instrument should be tested for shorts before mounting in the cabinet, the batteries temporarily connected to the terminals, and each socket tested successively with one tube, or a test lamp of the flashlight type, before placing all the tubes in the sockets. Turn up the rheostats for this test. If all connections are correct,



Cabinet with Loud Speaker Partly Drawn Out

turn off the rheostats and place all the tubes in the sockets. The instrument can now be mounted in the cabinet and the battery terminals connected; the terminal

MATERIAL LIST

1 bakelite or formica panel, 3-16 by 7 by 14 in.
1 baseboard, ½ by 9 by 13¾ in.
1 Cardwell variable condenser, .0005 mfd.
1 vernier dial.
2 audio-frequency transformers, ratio 3½ to 1.
3 Dubilier duratran radio-frequency transformers, range 225 to 550 meters.
6 tube sockets for UV-199 or C-299 tubes (spring or sponge rubber base).
1 small toggle filament switch.
1 by-pass condenser, 1 mfd.
1 6-ohm rheostat.
1 20-ohm rheostat.
1 2,000-ohm potentiometer.
1 .00025 Dubilier grid condenser with clips.
1 3-meg. grid leak.
9 binding posts.
1 terminal strip, bakelite or formica, 3-16 by 5⅛ by 7½ in.
1 jack having three terminals; two springs; one break contact; frame insulated.
6 No. 6 dry cells.
4 No. 5156 Burgess B-battery units, 22½ volts.
1 No. 2370 Burgess 4½-volt C-battery.
6 UV-199 or C-299 tubes.
1 cabinet with built-in horn, and battery compartment as specified.
1 loop, standard type.

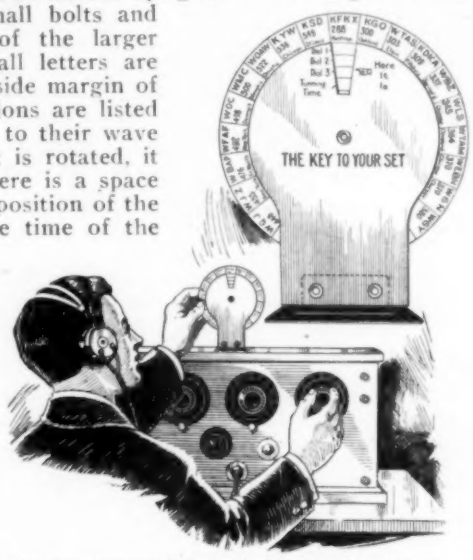
cord from the horn is brought through the wood partition and connected to the binding posts provided on the terminal strip, marked "horn." The loop is connected, and the set is ready for operation.

Do not screw the instrument panel permanently in the cabinet until the instrument is thoroughly tested on distant stations. It may be necessary to try several different tubes in the detector socket until one is found that gives the best results in this position. Also switch the other tubes around for best position. The grid leak is another critical instrument; try several leaks of varying resistances, for instance, a 2, 3 and 4-meg., one of which will be found to give the best results. The following instructions will be found helpful in tuning the set. Turn on the filament switch, turn up the 6-ohm rheostat which will be designated as the volume control, and the 20-ohm rheostat which controls the filament voltage on the detector and third stage of radio-frequency amplification, both to a point about two-thirds over. Also turn up the potentiometer to about the same point. Now slowly rotate the vernier dial on the variable condenser until the station whistle is picked up in the horn, then back off the rheostats and the potentiometer until the station comes in clear, at maximum volume. To obtain this result, it may be necessary to change the setting of the vernier dial, and also to turn the loop a little. The detector rheostat and the volume-control rheostat, together with the vernier-condenser dial, are the "tuning" elements. It is not often that the potentiometer setting need be changed, but it will be found critical on the distant stations. The settings of the rheostats will, of course, vary a little according to the condition of the batteries. The vernier-condenser dial setting will always remain the same on the same loop, and can be permanently logged.

Full-size blueprints of this set may be obtained by simply sending 10 cents, to cover the cost of wrapping and mailing. Address the Radio Dept., Popular Mechanics Magazine, 200 E. Ontario St., Chicago, specifying blueprint wanted.

Handy Logging Dial Aids in Locating Stations

A handy logging dial that acts as a key to the set is now available. The dial is placed on or near the receiving set. A metal base is provided to hold it upright, by means of two small bolts and nuts. Twenty-four of the larger stations with their call letters are listed around the outside margin of the disk. These stations are listed in rotation according to their wave lengths. As the disk is rotated, it will be noted that there is a space on it for logging the position of the various dials, and the time of the day the station is on the air. This space appears in the slot just below the station call letters. The reverse side of the dial is similarly arranged, to provide logging space for additional stations, so that the capacity of the log is 48 stations in all. Changing the length of the aerial, or moving the set to another location, of course, will make a variation in the position of the dials for tuning in a certain station.

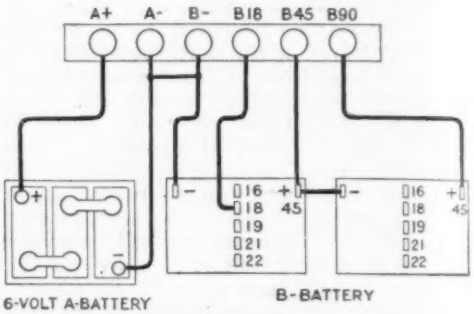


Showing Stations Listed on Margin, and Method of Mounting the Unit on the Receiver

The arrangement of the stations according to their wave lengths aids the operator in tuning to stations not yet heard, by comparing the settings of the control dials, on stations of similar wave length to that of the unlogged station. The operator would then know that by moving the dials a point or two either way, stations on wave lengths a little above or below the known setting, would come in. It is understood that the operator knows that the new station is on the air. A blank space is provided on the margin of the dial after each number, to be used if the wave length is changed.

Trouble-Shooting in Eight-Tube Superheterodyne Receiver

OUT of the hundreds of readers who have built the Popular Mechanics Superheterodyne-Eight, very few experienced any trouble, and these had either not followed directions, had overlooked one wire or some defective part was the cause. The experienced builder is as likely to overlook some essential wire as the amateur, and defective parts may fall to anyone's lot, so there is little to blame the builders for in these few cases.



Left, Testing Transformer; Upper Right, How the Batteries Are Connected; Lower Right, the Loop Jack

An imperfect instrument is generally harder to find than a missing wire. One of the small fixed condensers may be defective and cause spluttering that is difficult to trace. They are unbelievably delicate and extreme care should be taken in soldering them. One has a capacity of but .00025 mfd. and is used across the secondary of the tuned-stage transformer. This condenser is shown mounted in an upright position in the close-up. It is very critical, and must be as near its rated capacity as possible. The manufacturer has just placed a new type, known as No. 640, on the market, for which he claims a very close approach to perfection.

If your set splutters and fries, and the noise is not static, look to these condensers. Next to the one on the tuned-stage transformer, the 1-mfd. by-pass condenser across the total B-battery is most likely to cause trouble. If it is defective, the tone will be poor, especially when the loud speaker is connected in the horn jack.

Other possible trouble makers are the .006-mfd. condenser connected from the sixth tap of the coupling unit to the filament negative post of the oscillator tube, and the .0025-mfd. condenser connected to the No. 3 post of the coupler and the filament negative line.

Wiring troubles may range from omission of one or more wires to inductance caused by paralleling grid and plate leads, or leads cutting the electrical field of the coupler. The lead from the oscillator condenser to the grid of the oscillator tube should run under, not over, the coupling unit. Drop straight down from the condenser to the subpanel, run across it to the tube socket, and then come up to the grid terminal, and trouble will be avoided. Unless the prongs of the loop jack make contact properly, the wave-length condenser will have no tuning value. It may be necessary to bend the prongs until they take a firm hold of the loop plug.

A defective transformer is very rare.

Test it for open coils by connecting a dry cell and a pair of headphones in series, then applying the two loose end wires first to the primary and then to the secondary taps on the instrument. If the winding is in good shape, a distinct click will be heard as contact is made. If there is a break, there will be no click. Don't try to take the transformer apart and fix the winding yourself. Send it back to the dealer to be exchanged for a good one.

Make sure that the shields separating the banks of tubes do not touch any metal part of transformers, rheostats or potentiometer. Cut a notch in the shield to clear the projection if contact seems likely. If the right-hand shield is placed close to the first intermediate-frequency transformer, it is very apt to come in contact with the B soldering lug. Excess paste used when building the set may have run down the lugs and formed an insulating shield around the terminals which will cause trouble unless removed. In looking for excess paste, also go over the terminal nuts and tighten them thoroughly, and inspect every soldered joint to make sure that it is mechanically perfect and furnishes a good electrical contact. Such a joint should be so strong that you can grasp the wire with a pair of pliers and give a good pull without breaking the solder. A single loose terminal nut may cause an endless amount of trouble. One builder completed a set and it didn't work. He went over the wiring carefully, finding everything apparently correct. Finally he decided to change a grid leak, and at once the receiver worked. The trouble was that one of the connections was loose.

If a tube fails to light, the trouble may be that the spring clips do not make contact with the tube prongs. Inspect the clips and be sure that the tube is pressed down and turned into position.

The vernier rheostats specified have a nut that holds the arm in place, and this is very apt to become loose if the rheostat is turned up too far; see that these nuts are tight. This fault has been corrected by the maker, so users of the new style will experience no trouble.

The oscillator tube is another possible source of trouble. To tell whether it is oscillating, moisten the finger tip and place it on the grid terminal of the tube socket. A click will register in headphones or loud speaker when the terminal is touched and again when the finger is removed. If the tube is not oscillating, there will be but one click, instead of two. In this case, the tube may be worn out or defective; the socket springs may not make contact; the midget condenser or coupling unit may not be set properly; there may be an error in wiring, or the oscillator and master rheostats may not be turned up far enough to start oscillation. Both must be turned up to make the tube work.

Left, Testing the Master Rheostat; Right, Position of .5-Mfd. By-Pass Condenser below Sockets

Mistakes in connecting the B-batteries also cause trouble. There are three B-voltages used in the super-eight—18 on the oscillator plate and on the first detector-tube plate, 45 on the plates of the three intermediate frequency stages and the second detector, and 90 on the plates of the two audio tubes.

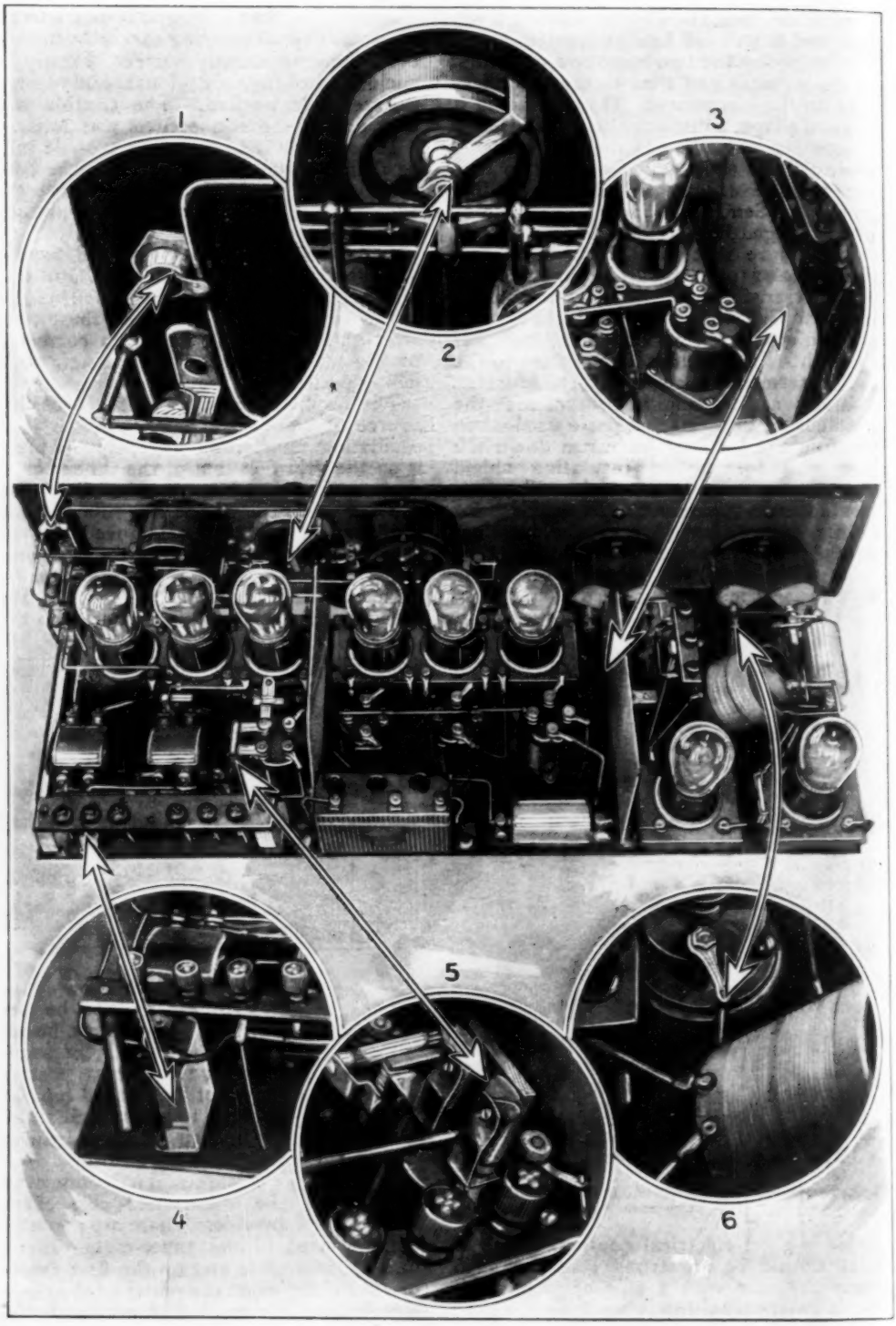


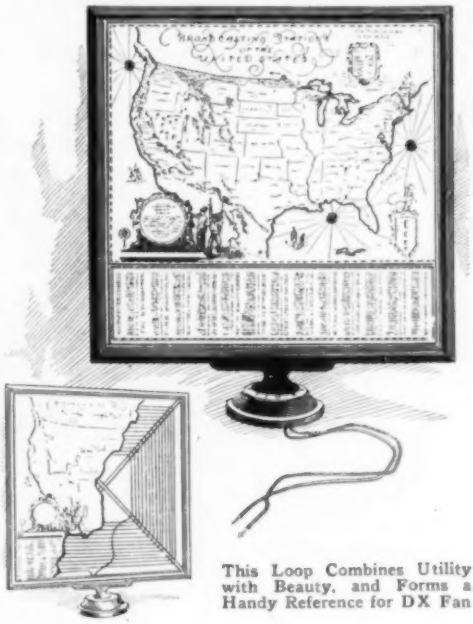
Fig. 1, the Pilot Light; Fig. 2, Potentiometer Nut; Fig. 3, Shield; Fig. 4, By-Pass Condenser; Fig. 5, .00025-Mfd. Condenser, and Fig. 6, the Wiring around the Coupler

Checking the wiring looks like a difficult task, but is simple if systematically done. Take the wiring blueprint and start with the negative filament, or A-battery line; then follow it through from the battery binding post until you have checked every tap on the blueprint with the corresponding connection on the set, marking each tap on the diagram with a cross as you go along. Then do the same with the A-positive line, following with the B-negative and positive and the 45 and 18-volt lines. Check also the wiring of the filament switch and panel pilot lamp against the diagram. The pilot lamp is wired across the A-lines, while the switch is in series in the A-positive line. In effect, the lamp is in parallel with the switch. The possible error lies in getting the light in series, the same as the switch, throwing its resistance into the filament line and causing trouble.

Another chance for error lies in reversing the leads from the .5-mfd. by-pass condenser which is mounted beneath the left-hand three-gang socket. One wire from the by-pass condenser goes to the center arm of the potentiometer, and, continuing from the condenser in the opposite direction, leads to the positive pole of one of the 1½-volt flashlight batteries. The two outside poles of the potentiometer are connected, one to the A-positive and the other to the A-negative line, and the other side of the by-pass condenser also leads to the A-negative line. The result is that when the potentiometer arm is set to give the proper negative bias to the grids of the three intermediate frequency tubes, the 1½-volt battery acts as a booster, insuring stabilization, and the bias does not depend on the drop across the A-battery as is usually the case. Both the small flashlight batteries and the 4½-volt C-battery should be tested to make sure they are not dead. Regeneration plays an important part in securing selectivity as well as volume and distance, but if carried too far the circuit will "slop over" and become mushy. Resistance within the set is one of the factors standing in the way of selectivity, and regeneration, when properly used, tends to break down this resistance. The midget condenser, mounted on the subpanel, is used to give just the right value of regeneration, and when once set, like the coupling unit, it requires no further attention.

Map on Loop Aerial Hides the Wires

A loop aerial with the wires concealed behind a colored map of the United States listing the principal broadcasting stations, has been devised for those who dislike the appearance of the ordinary article and also want a guide within convenient reach while using their sets. It is inclosed within a wooden frame of pleasing appearance and rests on a substantial base, upon which is a scale for marking the position of the loop that gives the best reception on the various stations. A special plug permits turning without twisting the connecting wires. The map is designed after those of the sixteenth and seventeenth centuries and is decorated with quaint old compasses and galleons such as were used long before radio sped across the oceans. The loop has sufficient wires to cover the wavelength range that can be received on a variable condenser of .0005-mfd. capacity.



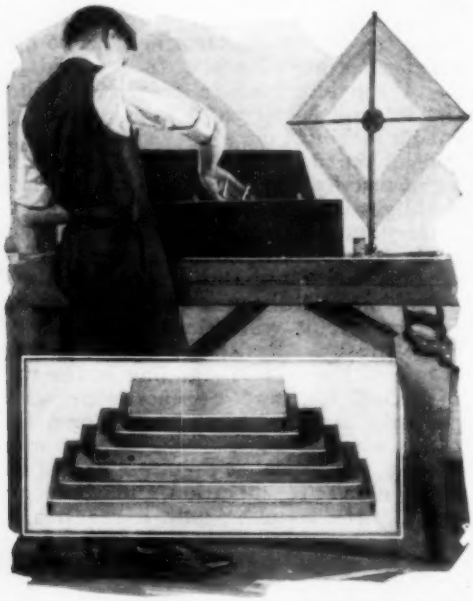
This Loop Combines Utility with Beauty, and Forms a Handy Reference for DX Fan

Metallic Grid Leak Is Stable

A metallic film of high resistance, which is actually annealed to a glass rod or tube, is the feature of a grid leak recently placed on the market. It is claimed that the resistance thus produced is unusually stable, due to the fact that the film cannot wear off, or become detached from the glass in any other way.

Knockdown Cabinet Readily Assembled by Amateur

So amateur radio builders may have the satisfaction of making their own sets



Above, Assembling the New Knockdown Cabinet; Insert, How the Cabinets Are Shipped

from start to finish, attractive cabinets are being put up in knockdown form. Each piece is carefully designed in every detail, and the outfit contains all necessary screws and bolts. A chart is furnished to guide the builder in drilling the set, and a screwdriver is provided to aid in the assembling. The cabinet parts are made of a special moisture-resisting compound which is claimed to eliminate current losses. Either hinged or slide lid can be had.

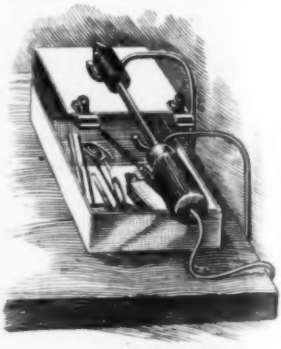
Spring Post Makes Quick Connections

Simplifying connections in the set wherever they are used, spring binding posts now on the market should make a hit with the radio fan. The posts are made in two styles, plain nickeled brass or with engraved hard-rubber caps, and in each style the method of installing and using is the same. The instrument is placed in position on the board and the post fastened in place,

then the wire is inserted by simply pressing down on the head of the post and slipping the wire into the slot in the side. The slot or the busbar wire can be turned in any desired position, and there is no hole to feel for, just a slot that is easily located no matter where the post may be placed.

Handy Box Aids in Soldering Radio Wiring

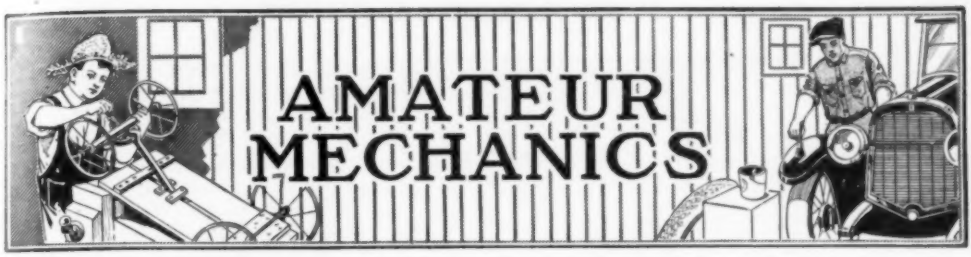
A small box of some kind is essential to hold flux, solder, and odds and ends in radio work, and the one shown in the drawing has been found very handy. A heavy tin box is formed, about 8 in. long, 1 in. high and 4 in. wide, and a top flap is bent over to make a 3-in. shelf. At the ends of this shelf are bored two small holes, and one finger piece of each of two common office clips, having about 1-in. jaws, is bolted through each hole. These form the equivalent of two small and



delicate horizontal vises—especially useful for a one-man job. They will be found excellent in the case of small jobs; for example, when soldering and unsoldering lugs, it will not be necessary to chase the lug all over the tin and finally catch it on lopsided, to be soldered again. It is where wanted and easily released. Also, in uniting two wires, soldering pigtails, tinning, or attaching a right-angled connection to a main wire, the clips will be found of value. Two wire supports for the soldering iron, fastened to the edge of the bench, and projecting over the bench, will also be found handy.—Harry W. Poor, Boston, Mass.

Fixing Condenser for Experiments

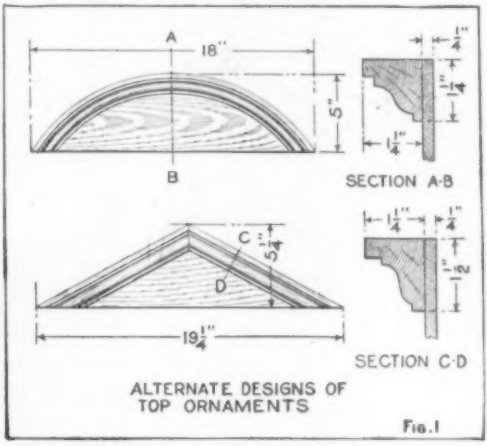
The fan who likes to tinker with new hookups soon finds that the terminals on variable condensers and similar instruments, are a source of trouble when he wants to make a quick hookup. If some Fahnestock clips are purchased and clamped under the regular terminal nuts, his trouble will be at an end as he can slip wires into or out of them in a moment.



Making a Hall-Clock Case

A Striking and Effective Design for the Hall Clock, Intended Especially for Amateur Woodworkers

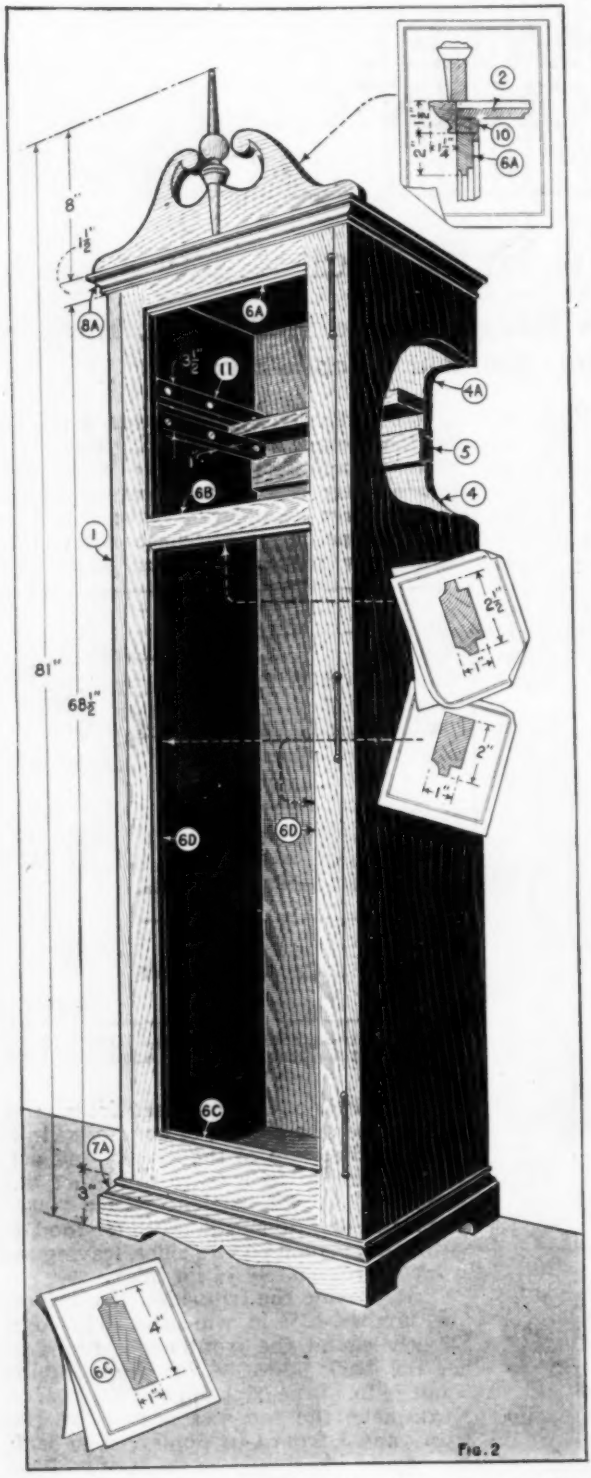
THE hall or grandfather clock is one of the most beautiful, as well as most useful pieces of furniture that the home owner can have. Clock movements in a variety of designs and at a wide range of prices to suit the pocketbook can be obtained from clock makers, but, the home owner may say, what about the case? Is not the making of a clock case above the capability of the amateur woodworker? It is not. The design shown in the accompanying drawings is intended especially for the average amateur, and, given a little patience and the ability to make neat joints, there is no reason why the home woodworker should not make a case as good as one he can purchase in the store. Mahogany makes the finest hall clock,



A Simple but Dignified Case for the Hall Clock Designed for the Amateur Craftsman; Above, Alternative Top Designs

but walnut is now being used frequently. The choice of material, of course, will depend on the taste of the maker, and perhaps on the wood used in the other hall furniture. In this article, where "inch" lumber is mentioned, it is understood to mean 1-in. planed on two sides, leaving the stock approximately ⅞ in. thick.

First provide the two sides, No. 1, from inch lumber, 12¼ in. wide and 70 in. long. Slightly round the front edges and rabbet the back edges ¼ in. deep, leaving about ¼ in. at the back edge of the boards. Next make the top and bottom boards, Nos. 2 and 3, from 1-in. poplar. The back, Nos. 4 and 4A, should be made of built-up panel stock, preferably birch, ¼ in. thick



Perspective Drawing of the Clock Case, with Details of Moldings

and 17 in. wide. The length of each of these pieces is determined by the position of the back piece, No. 5, and this, of course, depends on the clock movement used. It should, however, be approximately 12 in. from the top; and be made of poplar, 3 in. wide and 17 in. long, rabbeted on both edges and screwed into place as a brace for the case and an edge support for the two back boards. Both ends should be rabbeted to fit in between the sides of the case.

Next build the door to fit the frame. The side rails, No. 6D, are 2 in. wide and are rabbeted inside, ½ in. wide and ⅜ in. deep, to hold the glass, which is fastened in place with strips approximately ¼ by ¼ in. in dimensions. The center door rail, No. 6B, should be 2½ in. wide, and the lower rail, 6C, 4 in. wide. The front edge, around the glass, may be beveled or curved to add to the appearance of the door.

The lower molding and the sides, Nos. 7 and 7A, respectively, are made of 1-in. stock; the upper edge is molded and the lower edge band-sawed or cut with a turning saw to the shape indicated in the drawings. The upper molding, No. 8A, is 1½ in. high and 1¼ in. thick, and both the top and the bottom moldings are mitered. The door-stop molding, No. 9, is ⅜ by ½ in., around the inside of the door.

The filler strips, No. 10, 1½ in. wide and 1 in. thick, finish off the inside top and bottom of the case, besides providing a sill for the lower door strip. See Fig. 3 for details.

Three alternative designs are shown for the top; the one on the clock case and two in Fig. 1. These may be taken as suggestions, but there is considerable opportunity for original design in making the top.

The bottom view, Fig. 3, shows how the bottom is screwed to the lower edge of the sides; No. 5 wood screws, 1½ in. long, are used for this, and blocks are glued into the four corners to reinforce the lower molding. The top is similarly fastened to the upper ends of the sides, but no corner blocks are required here. The

door is hung with three 2 by 2-in. ball-pin hinges, and a mortise lock and a neat escutcheon should be provided for locking the door. The movement supports, No. 11, consist of 1-in. poplar strips, screwed to the sides of the case, and should be 3½ in. wide, grooved through the center of their entire length ½ in. deep and ⅞ in. wide. The movement, when the case is finished, is mounted on a board fitted to slide in the grooves. The slides should not be screwed in position until the movement has been selected and is on hand, as different movements require the slides to be mounted in the case at varying positions. The reason for splitting the back into two parts is to permit ready access to the movement. This may be had by merely removing the upper section of the back, which is held in position by means of two ⅞-in. screws on each of its four edges.

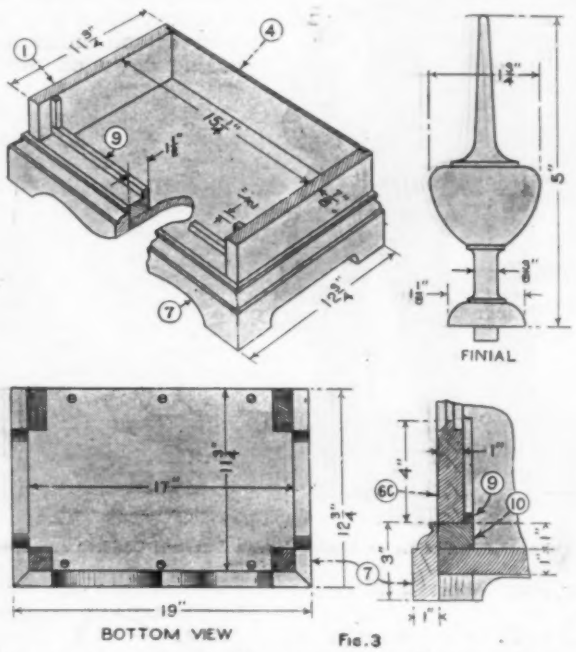


FIG. 3

Details of the Bottom Molding, Finial and Method of Fastening Bottom and Reinforcing Lower Molding

Flypapers and Poisons

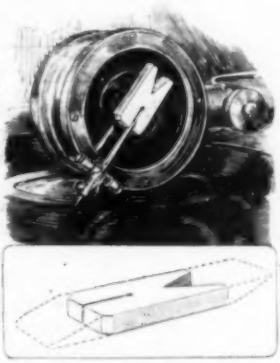
Sticky flypapers are of some value for destroying flies in the house, but they have numerous objectionable features. For use out of doors, traps are much more effective and economical.

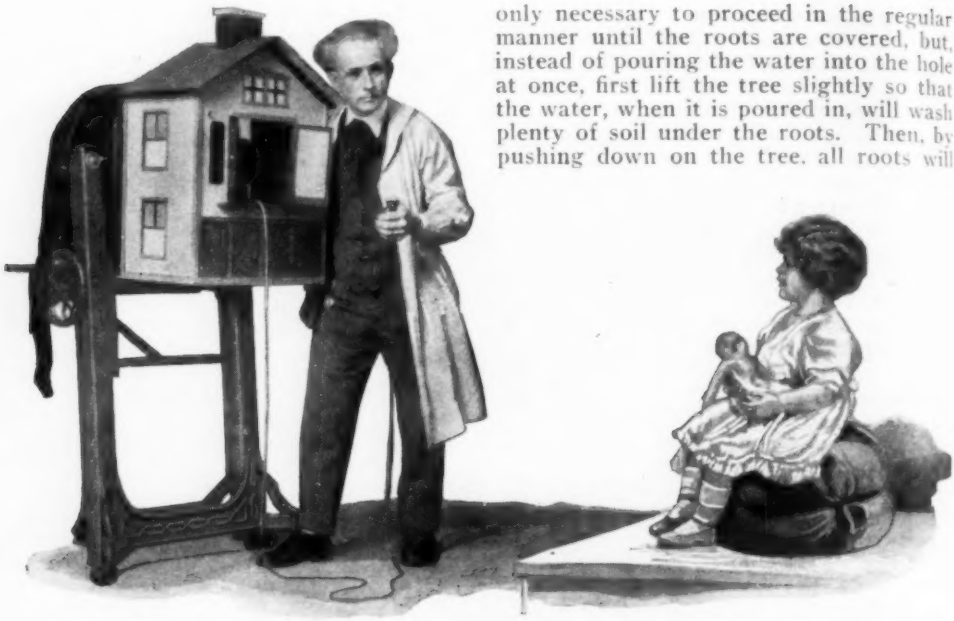
However, to make a sticky flypaper, take 2 lb. of rosin and a pint of castor oil and heat them together until the mixture has the appearance and consistency of molasses. Take a paintbrush and smear, white hot, on sheets of paper and place several about the room.

A non-poisonous fly killer recommended by the public health service consists of a 1-per-cent solution of sodium salicylate. This is prepared by dissolving three teaspoonfuls of the pure chemical in 1 pt. of water, some brown sugar being added to render it more attractive to the insects. Probably the best poisoned bait for houseflies is formaldehyde and milk, used in the proportion of two teaspoonfuls of formaldehyde to 1 pt. of a mixture composed of equal parts of water and milk. This is placed in flat dishes in places frequented by flies. It should be borne in mind that formaldehyde is poisonous when taken internally. It should not be inhaled, nor should the eyes be exposed to it. Special pains should be taken to guard children from access to poisoned fly baits and to prevent the dead insects from falling into food and drink. The most effective poison for the larvæ of the common housefly is powdered borax.

Mute for Phonograph

When it is desired to reduce the sound volume of a phonograph not equipped with a mechanical control attachment, the improvised rubber mute shown in the illustration will be found effective without giving that "boxed - up" effect that is produced when the doors of the sound chamber are closed. The mute is cut from a 5-cent eraser, split halfway up the center and notched at the other end as shown in the detail. This makes it easy to attach.





Play House Arranged over Front of Large Studio Camera Interests Children and Results in Better Photos

Getting Better Photos of Children

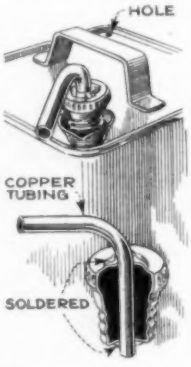
Children from 3 to 7 years old are, as a rule, difficult to photograph because the big black camera scares them. To avoid this effect, a Cincinnati photographer mounted a toy house over his camera, in order to arouse the child's interest and cause an expression of animation on its face that would make for a pleasing portrait. The idea works like a charm, he says, and children do not mind having their pictures taken. Consequently, the work turned out is of the best, so that the device also has its advertising advantage and is a well-paying investment.—J. R. Schmidt, Cincinnati, Ohio.

Planting Trees

Many fruit and shade trees die every year, in spite of the care they receive, because of a seemingly insignificant neglect at the time of planting. When the roots of the tree are placed within the hole and covered with dirt, a quantity of water is usually poured over them and this causes the soil to settle to such an extent that large open spaces are often formed on the underside of the root branches. As the real feeders of the root system are on the underside of the roots, it goes without saying that those along these cavities will not develop and the tree will consequently be undernourished. To avoid this, it is only necessary to proceed in the regular manner until the roots are covered, but, instead of pouring the water into the hole at once, first lift the tree slightly so that the water, when it is poured in, will wash plenty of soil under the roots. Then, by pushing down on the tree, all roots will be forced into the soil so that they will begin to take up nourishment and develop instantly.—G. E. Hendrickson, Argyle, Wisconsin.

Spout for Large Oilcans Facilitates Pouring

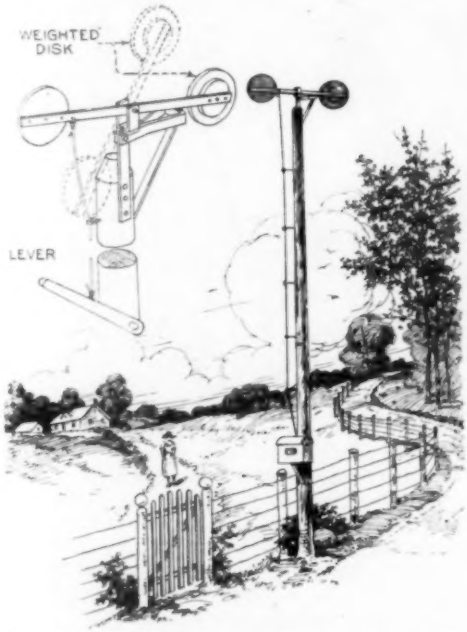
Five-gallon oilcans, such as are commonly used by the car owner to purchase and store oil, are rather unhandy to pour from, especially if the can is full or nearly full, as it is then impossible to hold it close enough to permit a steady stream without spilling. A piece of ⅜-in. copper tubing, about 4 in. long, bent to a 90° angle, as shown, and securely soldered in the regular filler cap of the can, eliminates the trouble. Holes are drilled through the top and bottom of the cap to receive the tubing and the cap is screwed down tight. The tubing is slipped into the hole, and turned until the bent part is parallel with one side of the can, with the cap tight. Mark the spot on the cap, and, after removing it, solder the tubing in place. If a small air vent is



punched in the top of the can, opposite the cap opening, the oil can be poured without "gulping."—Richard C. Tarr, Gloucester, Mass.

Farmer's Mail Signal

A Maine farmer, whose home is situated nearly a mile from the highway where the mailbox is located, made a semaphore to enable the mailman to signal the delivery of mail. It consists of two disks attached to a crossarm, which is pivoted at the top of a high pole and connected to a lever at the bottom of the pole to permit changing their position. One of the disks is weighted so that when the lever is not drawn down the crossarm is horizontal. The other disk is about 18 in. in diameter and painted like a target. A length of galvanized-iron wire is attached to the crossarm near this disk and to the lever, which is pivoted on the post. When mail is delivered, the mailman simply pulls down the lever and slips the end under a rope loop to keep it in this position. This pulls the painted disk down and tells the farmer that there is something in the box. A great many trips to the mailbox are eliminated by this device. The arrangement of



Semaphore near Mailbox Saves Farmer Many Unrewarded Trips

the bracket on which the crossarm pivots is shown in the drawing.—Sam E. Conner, Auburn, Me.

Handy File Plane Used to Smooth Curved Surfaces Such as Boat Hulls and the Like

A File Plane

For smoothing the hulls of boats and for many other similar purposes where the usual method of planing is impossible, a file rigged up like a plane, as shown in the illustration, will be found very satisfactory. The attachment is easy to make as it consists simply of a block with a handle and knob fastened to the top and clamps on the sides, which are tightened with screws. The clamps hold the file securely, but must not project below the lower surface of the file.

Cement for Water Tanks or Aquariums

A reliable cement that adheres to glass, wood, stone or metal, and hardens under water, and is therefore particularly suitable for use in building small water tanks or aquariums can be made by mixing litharge (oxide of lead), plaster of paris, dry white sand, and finely powdered rosin. Take equal parts of the first three ingredients and one-third part of rosin. Mix these well and sift, and keep in a tightly corked bottle until needed. It is then made into a putty by mixing with boiled linseed oil and a little drier. Do not prepare more than is necessary for immediate requirement. It will resist the action of either fresh or salt water. After application, allow the tank to dry for 10 or 12 hours before putting in water. This cement overcomes the greatest difficulty experienced by most persons in trying to make a waterproof aquarium.—Chas. Illingworth, Vancouver, Can.

Building a "SCENIC" COASTER

by K. D. Reynolds

"The Race through the Grass" in Full Swing; Below, Bottom View of Car

HERE is the newest thriller of the youngsters' world—the homemade "scenic" coaster. Built in the hills of North Berkeley, Calif., by two boys aged but 15 and 17, it is guaranteed by the kids of the neighborhood to provide more thrills per curve and hump than the most ambitious coaster that can be found in an amusement park.

Richard Leonard and Ysidro Orpano, the "promoters" of the enterprise, selected a vacant lot that slopes abruptly to the shores of San Francisco bay as the site of their coaster, then they started gathering the lumber, consisting mainly of scraps from new houses that were being built near by, and lumber from an old garage torn down in the vicinity. The cost of the necessary nails and the upkeep of the coaster have been provided for by charging the passengers one cent a trip. And what a cent's worth the juvenile passengers get! There are ten gliders or cars on which the riders go flying down the hill, through switches, around curves and over humps where one shoots through the air for a distance of from two to four feet, depending on the weight of the passenger, before alighting again on the rails and speeding onward. Farther on, the rider runs under a trestle over which other gliders are rushing, and now over a level crossing, just missing another car approaching on another track!

There are 960 feet of track in all, and there are several miniature stations along the route that serve as storehouses for the paraffin used to "grease" the slide. The cost of the latter is also taken care of by the income derived from the neighborhood's pennies. When this article was written, the builders had collected over $10, representing more than 1,000 rides.

The track is built of 6-in. boards, with laths nailed down the center to make a guide rail. The passenger rides on a simple sledlike car that has two iron-shod runners at each end, spaced far enough apart to slide easily along the lath. The

accompanying drawings and photos will give any boy who wants to emulate the builders a good idea of the construction of the cars and the track, which, of course, can be modified in any desired way to suit the material at hand; it is difficult to see, however, how it could be made much simpler. A little paraffin rubbed on the track and guide rail at the start of the day gives plenty of speed to the ride.

The main thing to be observed in building the track is that if any trestles are used they must be strong enough to support the weight of the heaviest person who is likely to use the coaster. Use the heaviest lumber of that available for the trestles and be sure that it is well braced in every direction. The cars can be provided with wheels if desired; these may be taken from old roller skates and this should provide even more speed than the sled runners. The skates could be used "as is," and the center guide rail on the track replaced by laths nailed at each side, so as to form a groove for the roller-skate wheels to run in, and prevent them from jumping from the track.

Not only the children use the "Race through the Grass," for, on the day when these pictures were taken, one full-grown man, who was at least 40 years of age, went shooting down that slide at about 30 miles an hour, yelling like an Indian every foot of the way, evidently enjoying it immensely. The writer rather envied him.

How to Care for Shoes

The life of shoes may be considerably prolonged by the exercise of a little care. It is a curious fact that if a wet shoe is placed close to a fire, the interior of the sole is sometimes completely ruined before the surface of the leather shows any appreciable signs of injury. The temperature of a steam radiator is also sufficient to injure a wet shoe sole. Shoes should be dried slowly, and, if possible, shoe trees should be inserted in them to prevent them losing their shape and becoming uncomfortable. It is therefore a matter of economy to keep two or more pairs of shoes and wear them in rotation. Some leather manufacturers claim that two pairs of shoes worn alternately will outlast three pairs worn consecutively.

Shoes, when not in use, should be stored where there is circulation of air. Perspiration is bad for leather, and shoes wet in this manner should be dried as soon as possible.

Details of the Construction of the Track and Drawing Showing Underside of Car or Sled; Above, the Car at the Top of the Hill, Ready for the Dash down the Slide

Mowing Lawn Banks

With the aid of an additional handle on the lawnmower, the difficulty of cutting grass on banks is considerably reduced

Additional Handle on Lawnmower Reduces Difficulty of Cutting Banks

as it permits the worker to remain on top of the lawn yet hold the mower at the proper angle. The extra handle, about 8 ft. long, is screwed to the underside of the regular handle, and a brace is nailed between the two, as shown. The length of this brace depends on the slope of the bank; the steeper the bank the longer it will have to be in order to hold the mower at the correct cutting angle. When cutting the flat part of the lawn, the extra handle and the brace are removed.—Sam E. Connor, Auburn, Me.

Removing Rubber Tissue from Garments

When rubber tissue has been employed in the temporary repair of a garment, one often finds that it is almost impossible to remove it so that permanent repair work can be done with needle and thread. However, by sponging the spot with a cloth moistened with gasoline, the tissue will be dissolved so that it can be removed entirely without damage to the fabric. For the same reason, repairs cannot be made with rubber tissue immediately after a garment has been cleaned with gasoline. Even though it appears to be perfectly dry, the article should be aired for a day or so, or sufficient fumes of the gasoline will remain within the fibers to resist the attachment of the tissue.—G. E. Hendrickson, Argyle, Wis.

Chasing Flies with a Fan

By using the electric fan the fly swatter can be done away with and the house cleared of flies with very little work.

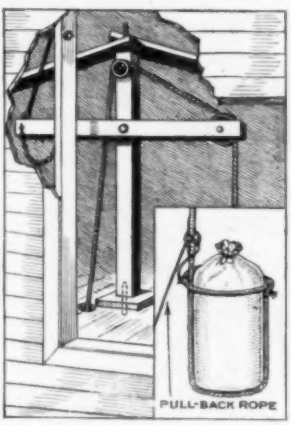
Raise a window halfway up, and draw the shade on it halfway down. Draw the shades on all the other windows down completely, thus allowing the light to come in only through the open window. Place the fan on a table or chair a few feet away from the window, facing it, and start the fan so that the draft will blow out of the window. The flies make for the light, and as soon as they come into the current of air from the fan they "hit the breeze" out of doors.—W. C. Martin, Cleveland, Ohio.

Diffusing Screen for Enlarging Lantern

A diffusing screen for an enlarging lantern is expensive and cannot be obtained everywhere. A good substitute can easily be made in the following way: Take an unexposed sheet of film from a film pack, and place it in the hypo solution without exposing it to light. After leaving it in this bath for about twenty minutes, remove and wash it like any other film. After drying, it will be found to make a satisfactory diffusing screen.—W. J. Latter, Halifax, N. S.

A Hoist for Filled Sacks

One man with the hoist illustrated can lift more sacks of wheat or other grain into the mow of a barn faster and with less exertion than several carrying the bags on their shoulders. A pivoted post is set up vertically at the proper position inside the mow door; a horizontal arm is attached to it by a single bolt and is kept in position by means of a ½-in iron rod that is fixed to eyebolts in one of the studs at the side of the door and in the end of the arm. When the lifting rope passes up and the ring comes against the pulley, the arm will be forced down at the opposite end. It



should be noted that the distance between the inner end of the arm is three feet or more from the studding, and, as the iron rod is attached to both, then, when the arm is forced down, it is also caused to swing toward the studding so that the sack of grain will be swung inside. The loop which holds the sack in place during the hoisting operation is made sufficiently large to be easily passed over the top of the sack; it holds the sack so, that though it may be securely tied when filled, there is little danger of its coming open. When the sack has reached its position in the loft, the pull-back rope is pulled by the man on the wagon below and the loop is lifted from the top of the sack so that it rolls free. The lifting rope and arm are returned to position for another sack as the pull-back rope is operated.

Effective Hawk Trap

When a hawk flies down over a chicken yard, the chickens scuttle for shelter, and the hawk usually alights on some near-by post from which to make its final pounce on the victim. Taking advantage of this,

Effective Method of Trapping Hawks in Farm Yard

a Minnesota farmer mounted a spring trap on each of three posts in his yard, as shown in the illustration, and found this method much more effective than trying to shoot the hawks. Sheet-metal flanges were tacked around the posts to prevent cats and squirrels from climbing up.—A. C. Brundage, Rochester, Minn.

Window Weights Lashed to the Bottom Rail of the Walker Make It Safer for the Baby

Making the Baby Walker Safe

With the ordinary kind of baby walker it sometimes happens that the child reaches over the top rail and falls, which is especially liable to happen when the walker is used outdoors on uneven ground. The trouble can, however, easily be prevented by tying two window weights to the lower rail, over the rear casters. This is a job that can easily be done in a few moments and will save the mother a great deal of worry.—Mrs. V. S. Martin, Detroit, Michigan.

Cleaning Paintbrushes

By using the following method paintbrushes can readily be cleaned and kept soft and pliable without keeping them in oil or water. When finished with the brush, clean it in gasoline; about two-thirds of a cupful is enough. Pour some clean gasoline on the brush and hold it in front of the nozzle of a garden hose or other strong stream of water, turning the brush around several times to wash out the gasoline. With the removal of the gas, every trace of the paint will also disappear. The brush is then laid away to dry, and it will be soft and clean for the next job. Even if used in black paint a brush will not soil a clean piece of paper when rubbed over it, after having been thoroughly cleaned and dried in this way. —Orin C. Watkins, Salem, Oreg.

Tools for the Home Mechanic

by J. Jate

THE man who likes to fuss with tools around the home—and what home owner doesn't?—is a rare and fortunate mortal if he has not discovered, to his exasperation, when halfway through a job, that some essential tool is not among his kit. Few of us tinkerers have all the tools we'd like to own, and no doubt many of those we'd like to buy would only be of use to us once in ten years, but how many men, when planning a house, or selecting the fixtures and furniture for it, spare a thought to the tools necessary for their upkeep? We take care that Mrs. Amateur Mechanic has all the tools she needs in her kitchen (if we don't, she does, so it amounts to the same thing), but what about the time when the handle will fall off the coffeepot? When the "missus" wants a few shelves knocked up in the closet? When the new storm door won't fit, or when the toaster cord breaks? Then, will we be able to go to the tool chest or workbench and dig up the screwdriver, saw, plane or pliers we need, or must we run out and try to buy them? Of course, this is not addressed to the man who says, "Oh, we'll get a carpenter" (or a plumber or an electrician, as the case may be). It is directed to Mr. Amateur Mechanic; to the man who gets more fun out of twenty dollars' worth of time spent in tinkering with tools than in paying out five to have the job done. Not that the ratio is always like that, far from it, but all Amateur Mechanics will agree that it's sometimes that way.

The list of tools to be included in the equipment for the home must, of course, be selected finally by the individual. The list given herewith may be too small for some; may contain too many tools for others; perhaps has not enough woodworking tools for some; not enough metal-working tools for some one else. It represents the average, however; and the man who has this kit, will find that it will take care of most of the jobs that are within his ability. The case of the man who wishes to work only in wood, or in metal, or has some other hobby, will be taken up in other articles; this one merely considers the requirements of the home worker.

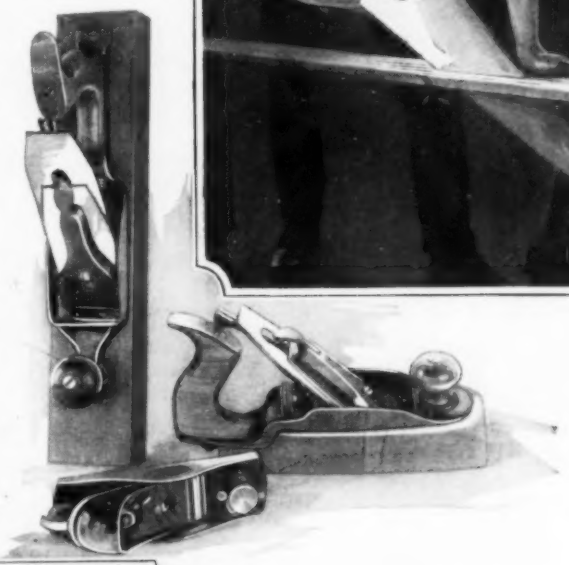
Type of Manual-Training Bench That Will Be Found Useful to the Home Mechanic; Note the Backboard for Tools

First in importance is the workbench, and it should be urged on all prospective home mechanics that the workshop be built around this. No serious work can be done without one. It need not be an elaborate affair—all drawers and compartments—in fact, the writer must confess to rather a prejudice against drawers and doors in a bench where woodworking

is done. It always seems to happen that, when one has a wide and heavy door clamped in the vise, one discovers a tool essential for the job is in one of the drawers behind the work! However, where space is at a premium, a few drawers help considerably. The construction of the bench is rather outside the scope of this article, and will be treated next month, but if the reader wishes to purchase his bench rather than make it, he will do well to purchase one of the sturdy little benches made for manual training. These are well made, with side and tail vises, and will serve for any job the amateur is likely to run against.

The tools, which are selected from the equipment of Popular Mechanics Model Workshop, are listed below.

This is not a "complete" set of tools. There is no such thing. Nor is it the minimum that a good amateur craftsman requires; it is to be regarded merely as a list from which to select or at which to aim. For example, the ripsaw may be omitted, as most odd-job work consists of cross cutting; the smooth or the jack plane may be omitted, as, on small jobs, a 6 or 8-in. block plane will serve very well; the gimlet, the 1-in. chisel and gouge; the 6-ft. rule; the 6-in. screwdriver; the reamer and countersink; the scraper; the 10-in. monkey wrench and pipe wrench; the



Above, Use of the Ripsaw; Center, Jack, Smooth and Block Planes; Below, Using the Crosscut Saw

long-nose pliers; the flat bastard and half-round smooth files; the blowtorch and anvil may all be omitted, and the tool kit still be satisfactory for its purpose. Nevertheless, there is not a tool in the whole list that would not at one time or another serve better than a substitute, and for this reason we recommend that, if it is at all possible, the whole outfit be purchased. It will then be an emergency indeed that will find the tool chest wanting.

Crosscut saw; 26 in.; 8 points.
Ripsaw; 26 in.; 5 points.
Nest of saws, containing compass saw, keyhole saw and nail-cutting saw, with handle.
Jack plane, iron; or iron with wood bottom.
Smooth plane, iron; or iron with wood bottom.
Block plane, iron.
Butt or pocket chisels, ¼ in., ½ in. and 1 in.
Firmer gouges, ½ in. and 1 in.
Auger bits, Irwin pattern; ⅜, ½, ⅝, ¾ and 1 in.
Expansive bit, ⅞ to 3 in.
Brace, 8 or 10-in. sweep, with ratchet.
Gimlet, wooden handle.
Push drill.
Nail hammer with bell face.
Riveting hammer.

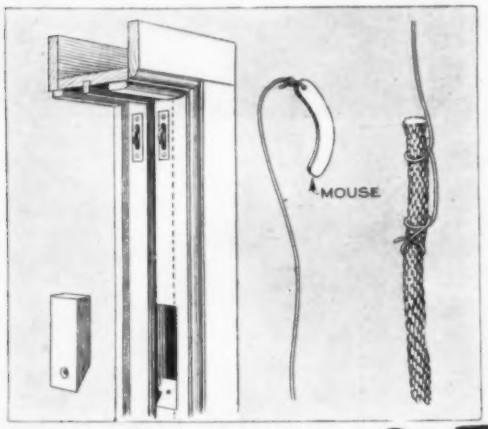
Mallet.
Ball-peen hammer, 13 oz.
Nail set, 1-16-in., cup face.
Try-square, 6-in.
Rules, 2-ft. folding; 6-ft. zigzag.
Screwdrivers, 4, 6 and 8-in.
Oilstone, soft Arkansas or Washita.
Oilcan.
Taper reamer.
Rose countersink for wood.
Cabinet scraper, 4-in.
Cabinet rasp, 10-in. half-round.
Hand drill.
Metal twist drills, 1-16 to ¼ in., also ⅜ in.
Hacksaw frame, 10-in.
Hacksaw blades, three, 10-in.
Cold chisels, ¼ and ⅝ in.
Monkey wrenches, 6 and 10-in.
Pipe wrenches, 6 and 10-in.
Pliers, slip-joint, 6-in.
Pliers, heavy cutting, 7-in.
Pliers, small long-nose.
Files, 6-in. saw; 10-in. flat bastard; 10-in. half-round bastard; 10-in. half-round smooth; 8-in. round; 6-in. knife.
File handles, 3 large; 3 small.
Soldering iron, plain or electric.
Blowtorch.
Centerpunch.
C-clamps, 6-in., two.
Putty knife.
Trowel, masons', 6 or 8-in.
Glass cutter and straightedge.
Small bench vise.
Small bench anvil.
Tool grinder, hand-driven.
Small wrecking bar.
Mouse.
Solder and flux, or acid-core and rosin-core solder.

A cheap tool is "a snare and a delusion," while a good tool, on the other hand, is "a joy forever"—or thereabouts. This is especially true of woodworking tools. Buy only those that bear the stamp of a reputable maker, and you won't have to spend time that should be used in productive work in trying to make and keep poor tools sharp and in good condition.

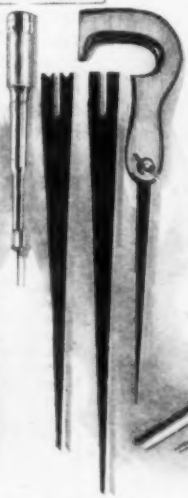
Little need be said about the use of the crosscut and ripsaws; their names are an indication of their purpose. The nest of saws, however, deserves a word. This consists of three blades, a compass, keyhole and another blade, which should be tempered to cut nails. All three blades are exceedingly useful, but only the man who has ruined a good saw when cutting through a partition or plaster will appreciate the third.

The jack plane, which should be about 15 in. long, with a 2¼-in. cutter, is used to bring the surface of work to a fairly true plane, and to give it the first "smoothing." The smooth plane is shorter, and, as its name implies, it brings the surface to a finer finish, as it cuts in the hollows that the longer jack plane does not touch. The block plane has its blade set at a smaller angle than either, and is very useful for cutting across the end of the grain.

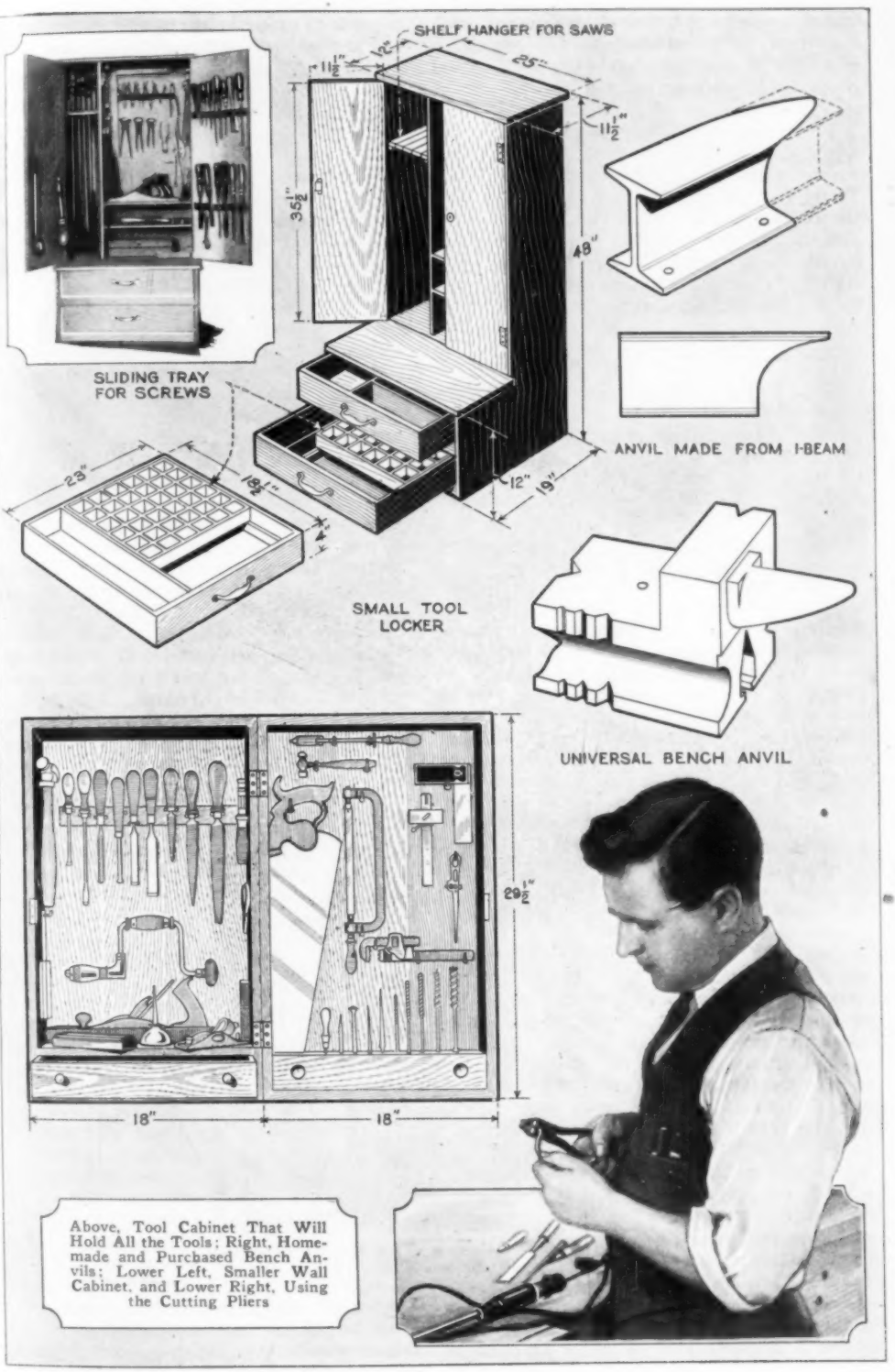
There are three types of chisels, butt, pocket and firmer; each of these is divided into straight-edge and beveled-edge, and into tang and socket chisels. The tang chisels have a tang or shank that is driven into a hole in the end of the handle; the socket-chisel handles fit down into a tapered socket on the chisels, and this is the preferable construction for the amateur. Whether to get beveled or straight-edge chisels is a matter of individual choice; I prefer the beveled-edge chisel, but that is partly because I do not like to strike a chisel with a mallet, other than a regular mortise



"Mouse" for Rethreading Window-Sash Cord, and Method of Tying Mouse Cord to Sash Cord



Left, a Small Vise Is a Convenient Tool; Center, Push Drill and Nest of Saws; Right, Socket Firmer Chisels, Showing How the Handles Fit



Above, Tool Cabinet That Will Hold All the Tools; Right, Homemade and Purchased Bench Anvils; Lower Left, Smaller Wall Cabinet, and Lower Right, Using the Cutting Pliers

chisel, preferring to use it as a paring tool. However, it is convenient on occasion to use a mallet—never a hammer—on a chisel or gouge, and for that reason the socket chisels are recommended.

The remaining tools need little or no description. The oilstone, it will be noted, may either be Arkansas or Washita. There are two grades of Arkansas stones, the hard and the soft. The former is especially adapted to sharpening highly tempered tools, requiring very keen, smooth edges, and pointed tools such as are used by engravers, die sinkers, etc. The soft Arkansas stone is better adapted to the home mechanic, as he uses it only for chisels, plane irons, etc. The Washita stone, of which the best grade is the "Lily White," is also an excellent one for the home worker, and is generally used by carpenters and joiners. It is capable of cutting rapidly and of leaving a smooth, lasting edge. Another good stone is the India, and "slips" of India stone can be had in a number of shapes, for sharpening gouges and special plane bits.

The bench anvil may be any heavy iron, steel or cast-iron block that will serve the amateur mechanic to "pound" on. Pieces of iron bar or heavy wire very often have to be straightened, and, in the absence of anything else, the temptation is strong to use the light vise. Don't do it! There are nice bench anvils to be bought, but this is not necessary; an 8 or 10-in. length of 6-in. I-beam makes a splendid anvil, and one flange can be cut away to make a horn if desired. A good heavy piece of flat steel will serve if nothing else is available, and will save breaking a corner off the stove, or chipping up the door step, when a length of ½-in. iron bar must be straightened. The last item on the list may puzzle some; this little "rodent" is a common carpenter's tool, however, and is very useful to the home mechanic when he has to replace a broken sash cord. It is nothing more than a curved strip of lead, about 3 in. long and ⅜ in. wide, with a small hole in one end to which is attached a piece of twine long enough to reach from the top to the bottom of the window. The free end of the string is attached to the end of the new sash cord, and the "mouse" is passed over the pulley and allowed to fall inside the box. It is then brought out through the pocket and the sash cord drawn after it. The weight is then fastened to the cord.

The manner of storing tools is again a matter of choice. I am, in this case, looking at the matter from the point of view of the house dweller. The inhabitant of a flat has only Hobson's choice—lock 'em up. The home owner, however, usually can find some space that he can call his workshop, and he can either have all his tools in plain sight or keep them in a locker as he chooses. I prefer the former method. A board, about 12 in. wide, and as long as the bench—or as long as necessary—is attached to the back of the bench, or to the wall behind the bench, and the tools are fastened to this with spring clips so that they can be "grabbed" instantly. Holders that will accommodate almost any tool handle can be obtained from tool-supply houses, and brass L-hooks will hold the remainder. The saws are hung on hooks at the right-hand end of the bench, and the planes are laid on edge on a 6-in. shelf above the backboard. A large number of tools can be accommodated in this way. When the tools are in place, take a pencil and run it around each tool, making an outline of the tools, in their proper places on the board, then fill in the outlines with black paint. The silhouettes tell instantly where each tool belongs, and actually help in keeping the bench tidy. It has been the experience of a number of home mechanics, the writer included, that this system is not only preferable to the locker, in point of handiness, but also discourages borrowing. There is no more fear of tools rusting when exposed in this way than when closed in drawers or in a locker. The bright parts of the tools should be wiped occasionally with a cloth saturated and wrung out in good light machine oil.

Boring a Large Hole in a Board with the Expansion Bit and Brace

Above, Using the Jack Plane; Center, the Smooth Plane in Action; Below, a Sawhorse Kit That Will Take the Bench to the Job

in either case. Don't use linseed oil; it will oxidize the steel.

For those who prefer the locker, two styles are shown in the accompanying illustrations. One is a large one, and will hold all the tools listed, with room to spare. It is made almost entirely of 1 by 12-in. finished lumber, and is divided into two sections. The cabinet section provides space for the larger tools and the drawer section contains nails, small tools, screws, etc. The details of the cabinet may, of course, be varied to suit the taste of the builder. The other is intended to be used in a flat, or where the full list of tools is not desired. Another scheme that was used by a reader of this magazine is shown in the drawing of the combination sawhorse and tool container. No description of this is necessary; it will not hold a great number of tools, but it forms a very convenient method of taking the bench to the job, as a small vise can be clamped to the top of the horse and many small jobs done right at the spot, instead of running back and forth to the workshop or bench.

Succeeding articles, to appear from time to time, will tell how to sharpen and care for the tools, as well as how to use them. Plan for the tool equipment of your home as you would for the remainder of it. Good tools are an investment that will return the home owner dividends in many hours of enjoyment, and, as he grows expert, in money saved by doing jobs himself.

Homemade Furniture Polish

A homemade furniture polish, which is cheap enough to permit its use on floors and woodwork, can be made from equal parts of benzine and rubbing oil, mixed thoroughly. This polish will not gum and will add considerable luster to the finest wood. About eight times as much of the polish can be made for the price ordinarily asked for a single bottle of prepared polish.

Novel Method of Teaching Geography by Means of a Round Concrete Pool, in Which Slabs of Stone Represent Land, and Water Represents Oceans

Realistic Method of Studying Geography

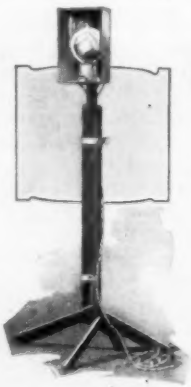
School children of Aviles, Spain, are taught geography and trade routes by means of maps of the two hemispheres laid out in two circular concrete pools, the continents and islands being represented by slabs of stone cut to resemble them, and the rest of the space being filled with water to represent the oceans. The two pools are connected by an opening in the wall and practically every island and country in the world may be found in this "atlas." The photo shows a Spanish boy explaining what route he would take from Aviles to St. Augustine, Fla.—Hamilton M. Wright, New York City.

Patching Auto Tops

The application of a patch to a torn auto top without removing the covering from the frame is often a failure, as it is difficult to apply pressure evenly over the surface of the patch while the cement is drying. A novel method of overcoming this is practiced by a Wisconsin motorist. After the patch has been cemented and applied, a small muslin bag, filled with sand, is placed over it, and the car is left standing in the sun until the cement is dry. The bag of sand accommodates itself to the curved surface of the top with the result that the patch will adhere along all the edges.—G. E. Hendrickson, Argyle, Wis.

Homemade Adjustable Floodlight

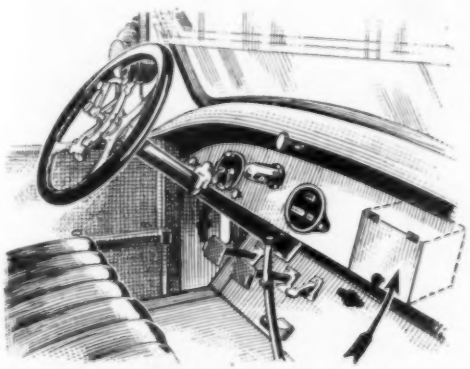
Amateur photographers will find a portable floodlight useful for interior work. The one shown in the photo is easy to make and the dimensions may be varied to suit the user. For portrait work, it should be constructed so that it can be raised seven or eight feet above the floor and lowered to within three or four feet of it. The standard consists of three lengths of ⅞-in. wood, about 2 in. wide, and should be of material that will not warp easily. A clamp, with a wing bolt attached, is provided at the upper end and a slide at the lower end as shown. These pieces are made of galvanized sheet iron, a hole being drilled through one side and a nut soldered over the hole to take the wing bolt. A piece of the same metal is screwed to the wood to prevent the bolt from wearing a hole in the wood when it is tightened. The clamp is screwed to the outside pieces of the standard while the slide is screwed to the center piece. Obviously, these pieces should be planed smooth and soap rubbed on to prevent binding. Three legs are screwed to the



lower end of the standard and the lamp reflector is attached to the upper end of the center piece. The reflector consists of a square tin box with one side cut out; an empty 1-gal. varnish can will do nicely. The sharp edges are bent over to prevent cutting one's hands. For ordinary work a 500-watt lamp has been found most suitable. A lamp of the kind used in some stereopticon lanterns will occupy little space. It is screwed into a cleat receptacle, which is bolted to the bottom of the reflector with machine screws, and a convenient length of lampcord with a plug attached, is connected to it. Where the lampcord passes through the bottom of the reflector a porcelain tube or a short length of electrician's loom should be used to prevent it from being cut or worn at this point, which would result in a short circuit.—W. E. Burton, Kenmore, Ohio.

Handy Compartment behind Dashboard Useful to Autoist

A handy compartment behind the dashboard of any automobile, whether open or closed, can be made in a short time and will be found very useful. With a keysaw, cut an opening, about 4 by 6 in. in dimensions, in the board and keep the piece cut out. Make a small wooden box to fit behind this opening, using ¼-in. hardwood and screwing it together securely. The edges of the hole are filed smooth and also the edges of the sawed-out portion, which is hinged so that it will swing upward when opened. A knob and catch at the bottom will keep it closed. If the work is done carefully, the finished job will be neat, and will afford a convenient

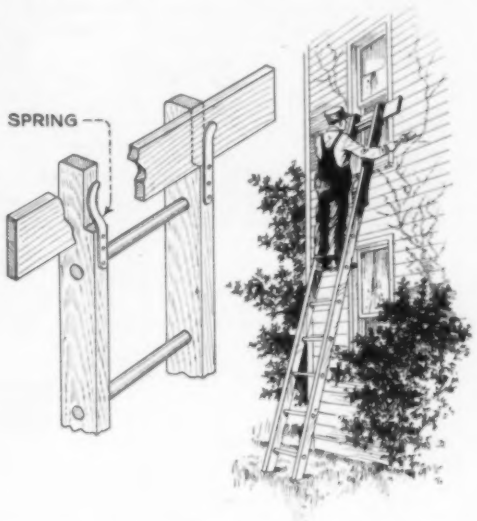


Compartment Built behind Dashboard Is Handy for Storing Trouble Lamp and Tools

place for the trouble lamp, oilcan, pliers and other small tools.—Grover Brinkman, Okawville, Ill.

Crosspiece on End of Ladder Aids in House Painting

When painting the side of a building, it is sometimes rather difficult to get near

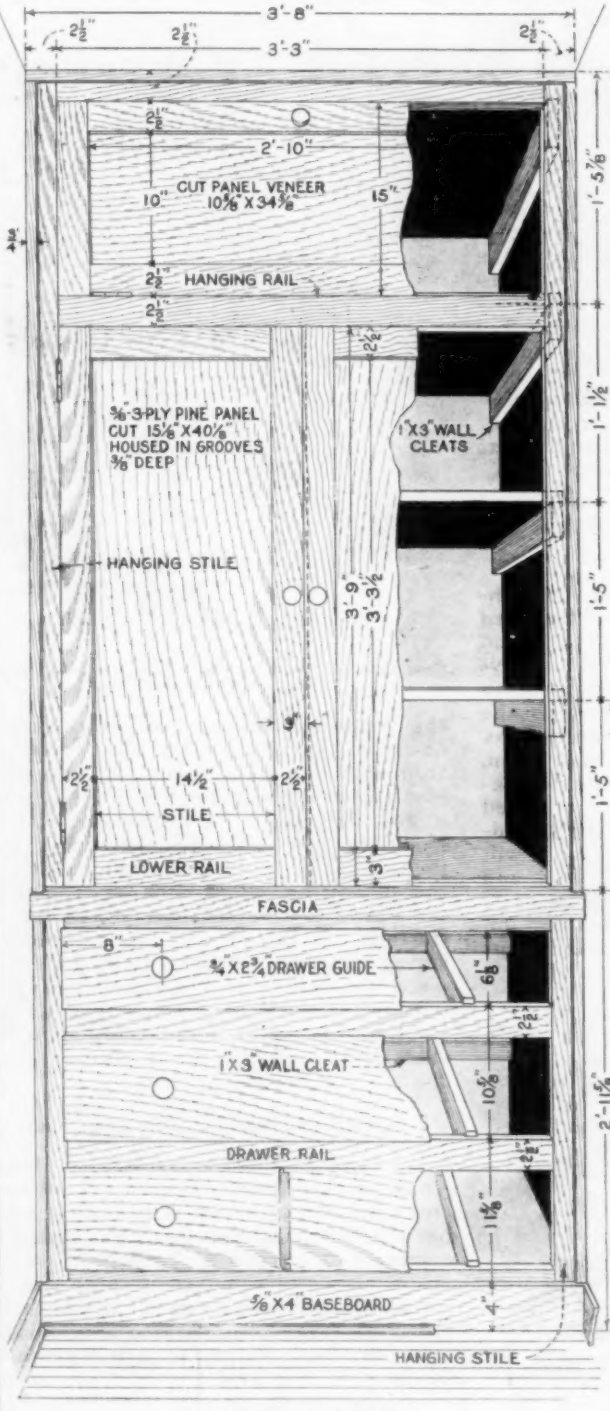


Crosspiece on End of Ladder Helps to Set It across Windows When Painting

the windows, because the ladder cannot be rested against them but must be moved from one side to the other, or one must lean across the window, which is awkward if not dangerous. A crosspiece of 1-in. wood on the end will overcome this trouble. The method of attaching it to the end of the ladder is clearly shown in the drawing. Notches are sawed out of the legs, as shown, and short pieces of spring metal nailed on to hold the crosspiece securely. This arrangement permits using the crosspiece or not, as desired, and is better than nailing it to the ladder.—J. J. Alpine, South Amboy, N. J.

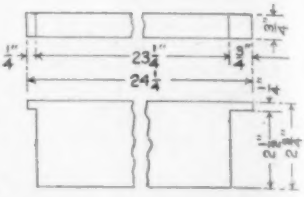
Soldering Flux for Iron and Steel

Iron and steel can be soldered provided a flux for this purpose is used. Some iron and steel fluxes cause considerable rust, but the following flux has been found to eliminate this trouble. In 1 pt. of muriatic acid, dissolve as much sheet zinc as it will absorb; then strain off the acid and put in as much concentrated ammonia as will turn the solution to a milky white. Shake this well and put in 1 oz. of sal ammoniac, ½ dr. of spirits of turpentine and 3 dr. of alcohol. Shake the whole well and keep ir a tightly corked glass bottle when not use.



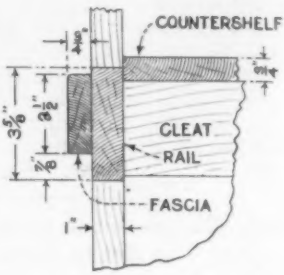
VIEW OF LINEN CLOSET

Fig. 1



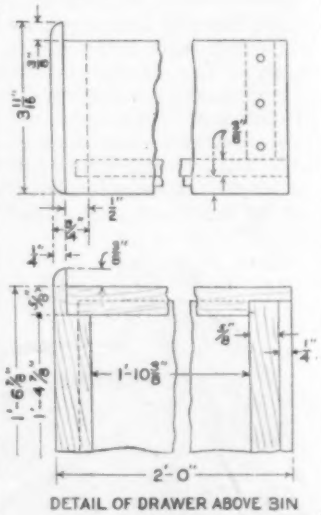
DETAIL OF DRAWER GUIDE

Fig. 2



DETAIL OF SECTION THROUGH COUNTERSHELF FASCIA

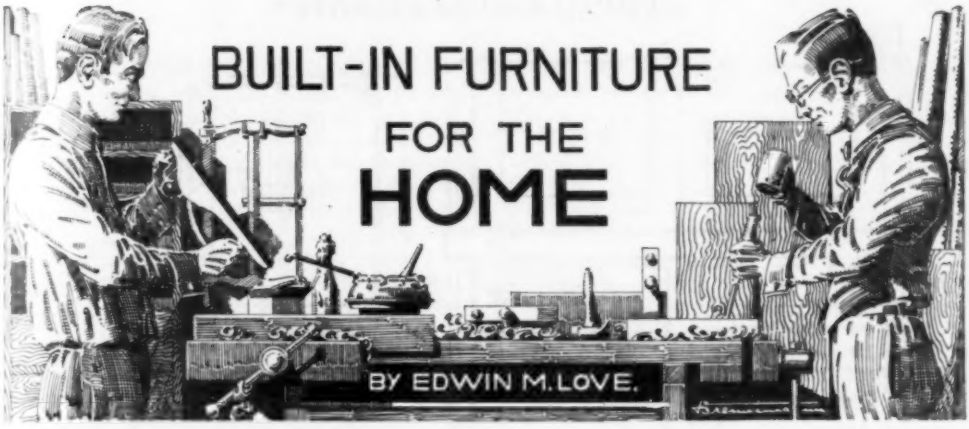
Fig. 3



DETAIL OF DRAWER ABOVE BIN

Fig. 4

Left, Front View of Assembled Cabinet with Full-Drawer Base; Right, Details of Drawer Guides, Drawers and Countershelf Fascia



Part VIII—A Linen Closet Easily Built

THE end of a hall, particularly if located near the bathroom, is an ideal place to build a linen closet. The one illustrated was built in a hall 3 ft. 8 in. in width from plaster to plaster, but the design is readily adaptable to use in a wider or narrower hall by simply changing its width, and by making the drop-door compartment above higher, it can be accommodated to a higher ceiling.

The front frame, 3 ft. 8 in. wide by 8 ft. 5 in. high, is built of 1⅛ by 3-in. pine, sized to 1 by 2½ in. net, except for the countershelf rail, which is 3⅝ in. wide, and the bottom rail, which is 4 in. wide. The hanging stiles run from top to bottom, with all the rails joined between by means of dowels. Stand the stiles on edge side by side, with face sides out and face edges up, and lay off from the bottom ends, 4 in. to top of the bottom rail, 11⅝ in. to the top of the next, 10⅝ in. to the next, and 6⅛ in. to the bottom of the countershelf rail. From the top of this rail to the bottom of the drop-door hanging rail is 3 ft. 9 in., and from the top of this rail to the bottom of the top rail, 1 ft. 3 in.

Using the assembled frame for measurements, lay off on a rod the distances from top to top of the drawer rails, and locate points ⅜ in. below the tops of the countershelf rail and hanging rail. Stand the rod in a corner of the cabinet space and transfer the points to the wall, leveling lines around to guide in nailing on drawer and shelf cleats. The tops of the cleats for the other two shelves are 1 ft. 5 in. and 2 ft. 10 in. from the countershelf cleats. Two feet from the back wall, if there is space to permit that depth of cabinet, plumb lines down on the side walls for alinement of the cleat ends. Nail shelf cleats made of 1 by 3-in. stock, chamfered on the inside lower corners, to the side walls, and against ceiling and floor nail other cleats as backing for the upper and lower ends of the frame. The drawer-guide cleats are of 1 by 2½-in. net stock, nailed on the back wall.

The shelves are glued up to width as placed. Joint up the 1 by 12-in. stock and cut such lengths as will slip snugly between the plaster. To one edge of four lengths glue a strip of 1 by 2-in. stock, nailing through the edge of the narrow strip with eight-penny finish nails. Nail these lengths to their cleats, narrow strip to the back. Fit the other widths so that, when placed, the front edges come flush with the ends of the cleats, and after coating both mating edges with glue, nail the boards in. Drive a couple of corrugated fasteners into the underside of each shelf, using a heavy hammer or handax, held on a protective block of wood as backing, to keep the shelves from driving loose. It is always well to prop each cleat with a stick bearing on the shelf below before attempting to nail up a shelf, so that the hammering will not loosen or move the cleat.

Set the front frame of the cabinet, plumbing the stiles. This may necessitate the chopping of the edges that bear against the plaster. Make no attempt to get a tight fit against the plaster, as the joints are concealed by ¼ by ¾-in. strips scribed to the walls and tacked to the stiles with brads. If the cleats and shelves have been carefully placed, the top of the countershelf will be ⅜ in. above the countershelf rail, and the drop-door shelf will project above its rail a like amount, acting as stops for the doors. Also, the tops of the drawer cleats will be level with the tops of the drawer rails. Nail through the frame stiles into the cleats they bear against, and through the countershelf rail

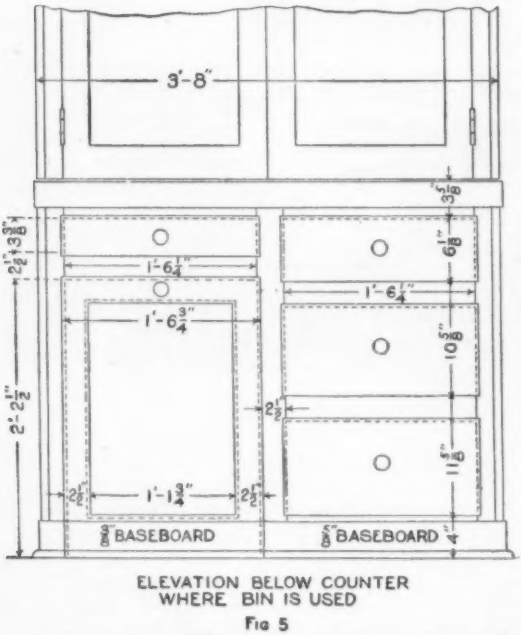


Fig 5

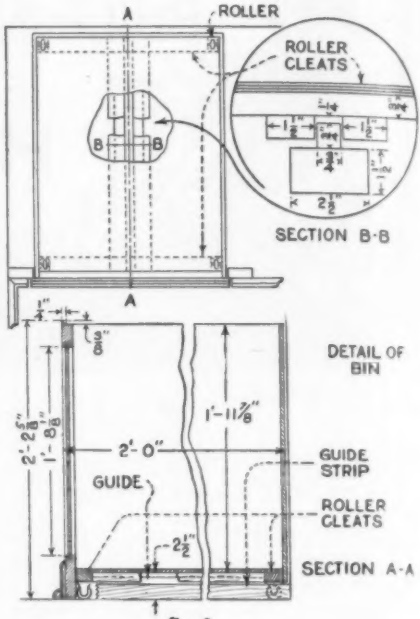


Fig. 6

Details of Alternative Construction of Base, with a Bin Below the Countershelf for Soiled Linen and Clothes on One Side and Small Drawers on the Other

and the drop-shelf rail into their shelves. Each drawer has two guides, placed 6 in. from the ends of the drawer openings. The detail gives necessary dimensions. The length, however, will vary slightly, owing to unevenness of the plaster at the back, for the rails must be kept straight. Toenail the front ends from the back, so that the nails will not show in the front of the rails, and keep the guides square with front.

In building the doors, notice that the lock stile of the left door is 3 in. net in width, rabbeted on the face side ½ by ½ in., leaving the face 2½ in. The corresponding stile of the other door is also 2½ in. wide on the face, but rabbeted on the back, to lap over the rabbet of the left door. So the total width of the left door is 1 ft. 8 in., and that of the right, 1 ft. 7½ in.

Give the drawers ⅛ in. clearance sidewise and 1/16 in. vertically, and leave a ¼-in. lip on ends and top of the front, ⅜ in. deep. Assemble front, sides, and back, and slide the bottom boards in afterward. Square carefully and drive several brads slantingly into the sides from the bottom.

MATERIAL LIST

1 piece, 1⅛ by 3 in. by 16 ft., pine or fir, S4S, sanded.
2 pieces, 1⅛ by 3 in. by 14 ft., pine or fir, S4S, sanded.
1 piece, 1⅛ by 3 in. by 10 ft., pine or fir, S4S, sanded.
1 piece, 1⅛ by 4 in. by 14 ft., pine or fir, S4S, sanded.
1 piece, 1 by 2 in. by 16 ft., pine or fir, S4S, sanded.
3 pieces, 1 by 3 in. by 10 ft., pine or fir, S4S, sanded.
1 piece, 1 by 3 in. by 14 ft., pine or fir, S4S, sanded.
1 piece, 1 by 4 in. by 12 ft., pine or fir, S4S, sanded.
2 pieces, 1 by 12 in. by 16 ft., pine or fir, S4S, sanded.
1 piece, 1 by 7 in. by 4 ft., pine drawer front.
1 piece, 1 by 9 in. by 4 ft., pine drawer front.
1 piece, 1 by 10 in. by 4 ft., pine drawer front.
1 piece, ⅝ by 7 in. by 4 ft., pine drawer sides.
1 piece, ⅝ by 9 in. by 4 ft., pine drawer sides.
1 piece, ⅝ by 10 in. by 4 ft., pine drawer sides.
1 piece, ⅝ by 6 in. by 4 ft., pine drawer backs.
1 piece, ⅝ by 8 in. by 4 ft., pine drawer backs.
1 piece, ⅝ by 9 in. by 4 ft., pine drawer backs.
3 pieces, ⅜ by 6 in. by 14 ft., T & G pine drawer bottom.
1 piece, ⅜ by 6 in. by 12 ft., T & G pine drawer bottom.
1 piece, ⅛ in. by 3 ft., by 5 ft., three-ply pine or fir panel veneer.
For bin, 1 piece, 2 by 8 ft., is required.
4 pieces, ½ in. by 8 ft., quarter round.
1 piece, ¼ by ¾ in. by 18 ft., pine, sanded.
1 piece, ⅝ by 4 in. by 4 ft., pine baseboard.
1 piece, ⅜ by 3½ in. by 4 ft., baseshoe.
1 lb. six-penny finish nails.
1 lb. eight-penny finish nails.
2 oz. ¾-in. brads.
½ lb. four-penny finish nails.
9 glass 1⅛-in. knobs.
2 frog catches.
1 elbow catch.
Time to build, about 32 hours.
Cost of materials, about $12.50.

Tracks for the guides are made by tacking a couple of ¼ by ¾-in. strips on the bottom, one on each side of the guide.

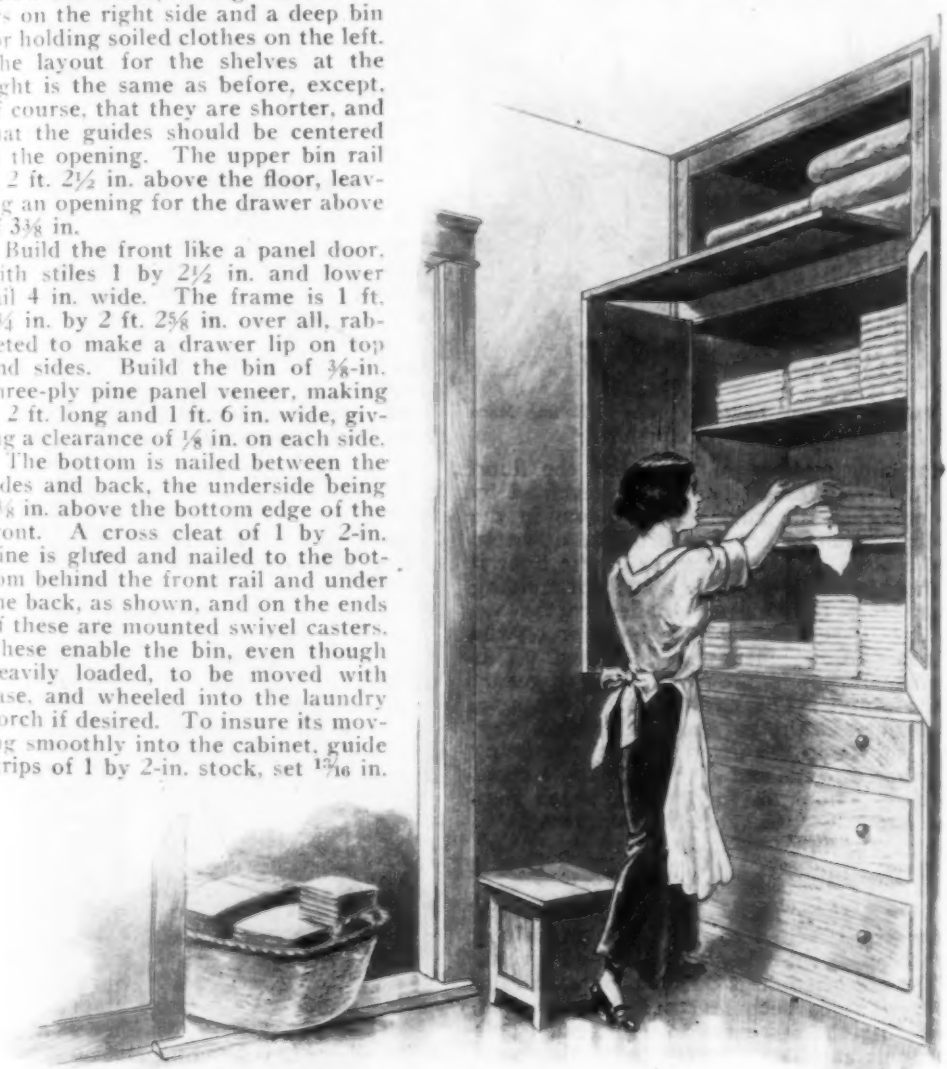
Nail a ¾ by 2½-in. fascia on the front of the countershelf rail, showing a margin on top of ¼ in. This not only looks neat, but prevents the doors from rubbing the top edges. Hang the doors with the hinges lining with the rails, and after painting put on the catches and knobs.

Cut the ⅝ by 3½-in. baseboard between the old base, fit the shoe, and sandpaper the cabinet thoroughly for painting.

A useful variation of the chest of drawers is to put a vertical stile in the center below the fascia, having short drawers on the right side and a deep bin for holding soiled clothes on the left. The layout for the shelves at the right is the same as before, except, of course, that they are shorter, and that the guides should be centered in the opening. The upper bin rail is 2 ft. 2½ in. above the floor, leaving an opening for the drawer above of 3⅜ in.

Build the front like a panel door, with stiles 1 by 2½ in. and lower rail 4 in. wide. The frame is 1 ft. 6¾ in. by 2 ft. 2⅝ in. over all, rabbeted to make a drawer lip on top and sides. Build the bin of ⅜-in. three-ply pine panel veneer, making it 2 ft. long and 1 ft. 6 in. wide, giving a clearance of ⅛ in. on each side.

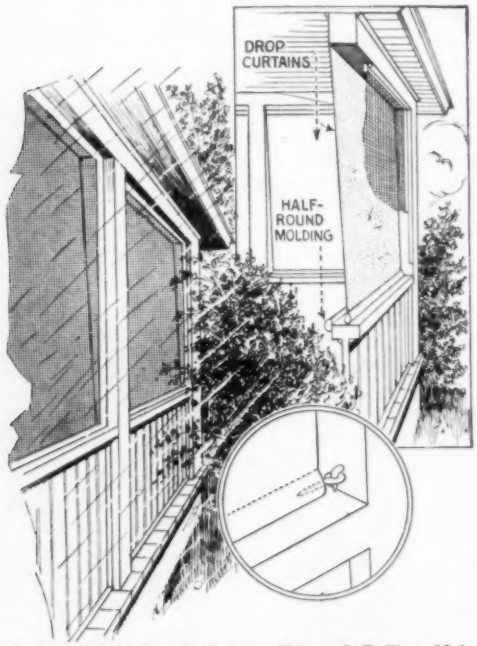
The bottom is nailed between the sides and back, the underside being 2⅜ in. above the bottom edge of the front. A cross cleat of 1 by 2-in. pine is glued and nailed to the bottom behind the front rail and under the back, as shown, and on the ends of these are mounted swivel casters. These enable the bin, even though heavily loaded, to be moved with ease, and wheeled into the laundry porch if desired. To insure its moving smoothly into the cabinet, guide strips of 1 by 2-in. stock, set $1\frac{15}{16}$ in. apart, are nailed to the cleats, running from front to back; and on the floor is nailed a guide built up of a base of 2 by 3-in. pine with a ¾ by ¾-in. strip on top, which slides between the guide strips on the bin. Soap or wax this slide, and widen the back end of the channel for an inch to facilitate replacing the bin after removal. Face the lower rail with ⅜-in. baseboard, ⅛ in. narrower than that on the rest of the cabinet, nail the shoe in place, and adjust the casters so that the front of the cabinet will clear the floor ⅛ in. Drawers, bins and shelves may be waterproofed with boiled linseed oil.



Here Is a Linen Closet That Can Be Built at the End of a Hall by the Amateur Craftsman in a Few Hours

Rain-Proof Sleeping Porch

It often happens during a storm that the rain strikes the curtains on the sleeping porch and runs down on the inside,



Strips of Molding Nailed on Edge of Railing Make Sleeping Porch Rain-Proof

forming puddles of water on the floor. This trouble can easily be prevented by arranging the curtains as shown in the illustration. They are brought down to the plate of the railing, or to the floor if there is no railing, and a strip of molding or other thin wood is nailed to the top edge of the plate or to the floor on the inside of the curtain as indicated. This makes it impossible for the rain to get on the porch. The curtains are, of course, fastened at the bottom in the usual way, as shown in the insert, a screweye being driven into the end of the pole and hooked on an L-hook, driven into the porch post, as shown.—J. G. Pratt, Washington, D. C.

Repairing Auto Curtain Fasteners

On many open cars the curtain fasteners are attached to the wood rail along the top of the body by two wood screws. The rail often dries out and splits, and the screw holes become rusty and enlarged, causing the fasteners to come off. This trouble can be prevented by bolting each fastener to a 2-in. strip of flat iron and screwing this to the rail. The upholstery binding tape is first loosened at the points where the fasteners are to be attached, holes are drilled for the nuts and bolt ends where the old screw holes are, and the strips then screwed down on the rail.—E. T. Gunderson, Humboldt, Iowa.

Preventing Bed from Marring Baseboard

Marks and cuts on a bedroom baseboard, due to moving the bed around, can be prevented by placing a narrow piece of hardwood on the floor along the edge of the baseboard, behind the legs of the bed. This forms a bumper for the casters, and it is then impossible to push them against the wall. The piece of wood may be painted or varnished and, in any case, is not likely to be noticed by the casual observer.—Charles A. Goddard, Los Angeles, Calif.

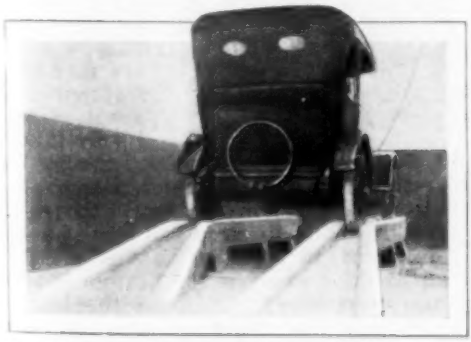
Separating Cream from Milk

A separator that siphons off the cream from a bottle of milk and automatically stops the flow when the cream line is reached, is shown in the illustration, and can be made for about the price of a bottle of milk. All that is necessary is a No. 11 2-hole rubber stopper, and a 15-in. length of 3/16 or 1/4-in. glass tubing. Two bends are made in the tubing, one about 8 in. from the end, and another 3½ or 4 in. from the first. The tubing can be bent by holding it in a gas flame or that of an alcohol lamp, turning the tube in the fingers and moving it back and forth in the flame so that it is heated for about 1 in. of its length. When it begins to bend of itself it is taken by the ends and bent gently, at the same time moving the point where it is bending most out to the edge of the flame. By bending slowly and spreading the bend over 1½ in. of the tube

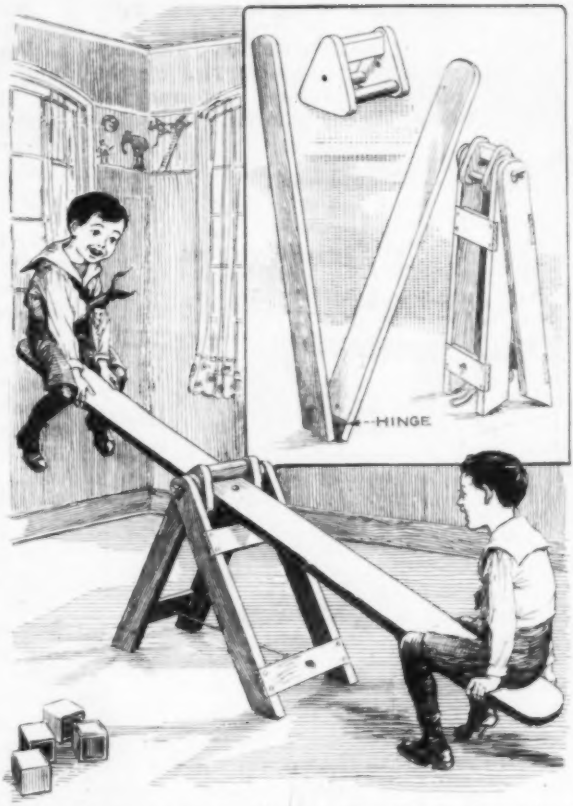
a smooth even bend will result. The tubing is broken off just above the second bend by scratching it on one side with a three-cornered file, grasping it on either side of the scratch with the fingers and giving it a quick snap. The rubber stopper is cut with a very sharp knife to leave a section 5/16 in. thick; this is laid over the mouth of the bottle and the outline of the mouth traced on the rubber. Concentric with this another circle is drawn, 3/8 in. smaller in radius; now, with a sharp knife a circular groove is cut around the stopper, about 3/16 in. deep, between the circles. The stopper and tube are then assembled as shown, and put in place so that the short arm comes to the cream line. Close the open hole in the stopper with the thumb and thrust sharply downward, then withdraw the thumb. The sudden pressure starts the flow of the siphon and it keeps on running until the cream line is reached.

Platform for Washing Autos

For washing automobiles, a concrete platform of the kind shown in the photo will be found neat as well as useful. The water dripping from the car is caught in the tracks and is drained through holes into a sump, thus preventing the dirty water from getting all over the floor. An incline, which is similarly grooved and is wider near the floor to make it easier to guide the car onto it, leads up to the platform. The edges of the concrete are, of course, rounded to prevent injury to the tires.—C. W. Geiger, San Francisco, Calif.



Elevated Concrete Runway Aids in Washing Car and Drains Away Muddy Water



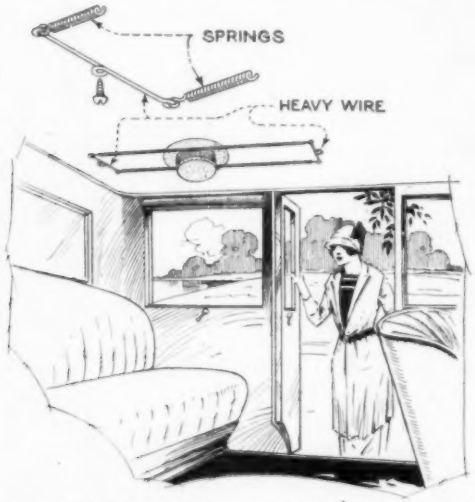
Collapsible Seesaw for the Playroom That Can Be Stored in a Small Space When Not in Use

Folding Seesaw Amuses Children Indoors

For the recreation and amusement of children during rainy weather when they cannot play outdoors, a seesaw of the kind shown in the drawing is especially suitable for the playroom. It is a folding affair so that it can readily be stored away in a small space when not in use, and its dimensions permit it to be carried around without much trouble. It consists of the three parts, shown in the detail. The board, of 2-in. material, well planed and about 6 ft. long, is hinged at the center with an ordinary door hinge securely bolted to it so that the leaves are on the top side. The frame is made of 1 and 2-in. material with a length of rope at the bottom to keep the legs from slipping too far apart. The pivot of the seesaw is made as shown in the detail, and bolted to fit the top of the frame so that it can swing freely. To add to the appearance of the toy a couple of coats of paint should be applied.—Geo. K. Heist, Winchester, Va.

Sedan Hat Rack Made from Springs

Hats are not usually needed when riding in a sedan, and when carried on the lap, are rather a nuisance. A novel hat rack, which holds the hats entirely out of



Hats Held Conveniently on a Spring Holder Attached to the Top of a Sedan

the way, is shown in the drawing. Wire braces are bent to the shape shown and are screwed to the ribs supporting the top. Two screen-door springs are then hooked to the ends of these braces, which have eyes formed at the ends, about 6 in. apart, so that the space between the springs will easily accommodate the crowns of the hats. The hats are slipped with the rims under the springs as indicated, and will be held in this position securely.—Frank Harazim, New York City.

Applying Undercoat for Enamel

One of the reasons that some enamel jobs do not turn out satisfactorily when done by an amateur, is that no attention is paid to the color or tint of the undercoating applied. Many professional interior finishers even commit this error, so there is some excuse for the amateur. The tint or color of the undercoating should be as close a match as possible to the enamel to be applied over it. There is another excellent reason for carrying out the above suggestion; in cleaning the enameled surface from time to time, it is bound to wear or become chipped. If the undercoating is of a different color it will show through the chipped or worn parts and, in that case, there will be no other remedy than repainting.

Bird Houses That Grow from Seeds

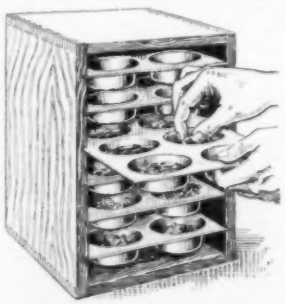
Weatherproof homes that the birds like and use may be made in unlimited number by simply planting a package of "dipper gourd" seeds along a fence; then, when the fruit is ripe, remove from vines, boil in a washboiler, scoop out center through small opening, and later run a wire through the top of neck for a hanger. Push a peg in below the hole for a perch. Allow them to dry for a few weeks. When dried, paint the inside and outside, and leave in the attic or anywhere handy until spring, when the birds are expected. The bird houses must be "weathered" so that there is no smell of paint, and they should be put in place before the first birds come.—Mrs. V. S. Martin, Detroit, Mich.

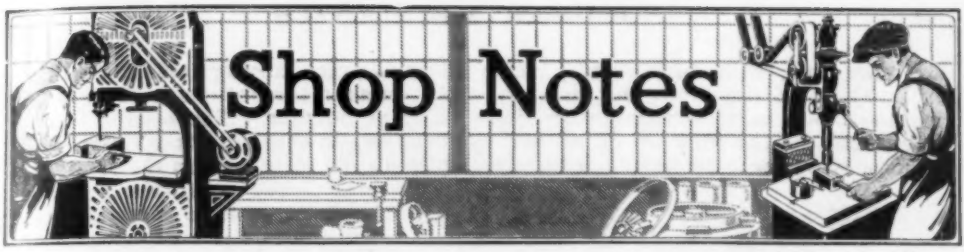
Repairing Holes in Water Pipe

A small hole in a low-pressure water pipe may be repaired in the following way: Take a piece of tinfoil of the type wrapped about certain brands of tobacco and confections, shape it into a sharp-pointed cone and tap it, point first, into and over the hole with a light hammer. Then wrap tightly with friction tape. A repair of this kind has been effective for over two years on an iron pipe carrying water at a pressure of 20 pounds.

Cheap Cabinet for Small Parts

A handy rack for holding small nails, screws, cotter pins, and the like, can be made in the following way: Obtain a stout wooden box, 7 in. wide, 10 in. deep, and about 16 in. long, inside dimensions, and half a dozen biscuit tins, which are usually rectangular in shape, about 7¼ by 10½ in. in dimensions, and have six circular depressions, 3½ in. in diameter. Remove the bottom of the box and saw grooves, ⅛ in. wide and ¾ in. deep and spaced about 2 in. apart, in the sides as shown. This can be done easily if the bottom is temporarily removed. Nail on the bottom again and slip the pans into the slots. They can be used as drawers or can be taken out separately.



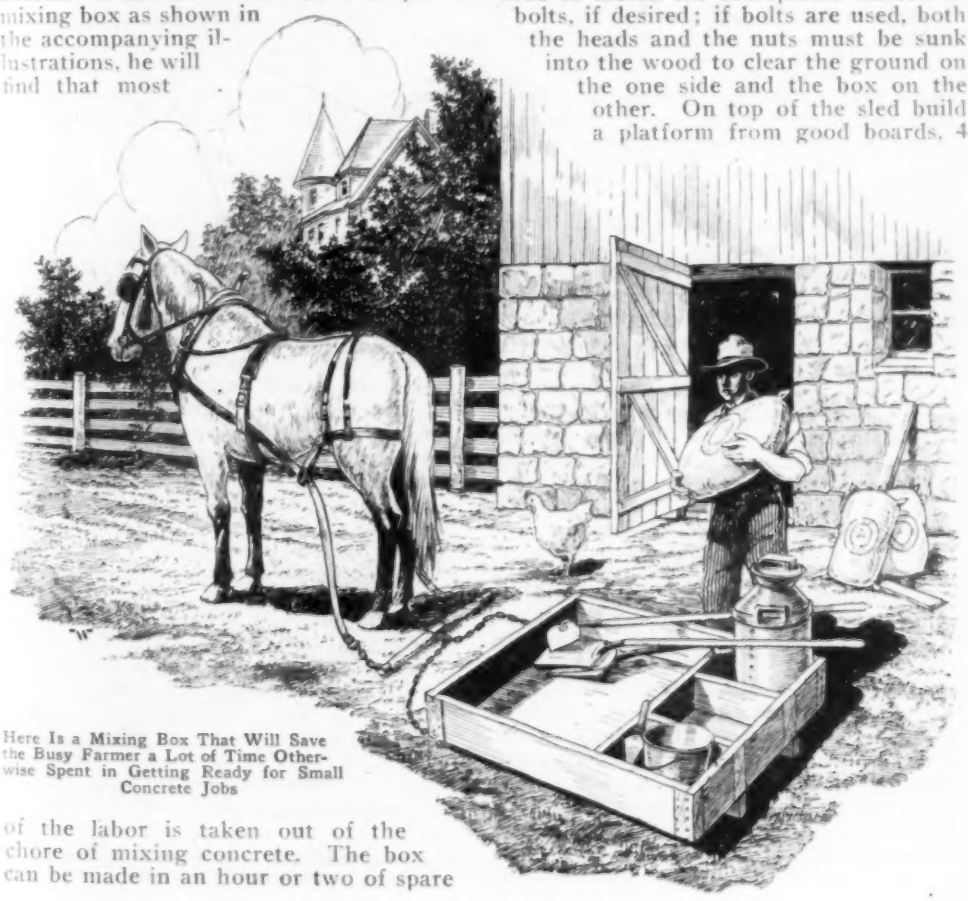


All Shop Notes published in 1924, in book form—Fifty Cents—from our Book Department

Mixing Box Aids Concrete Work

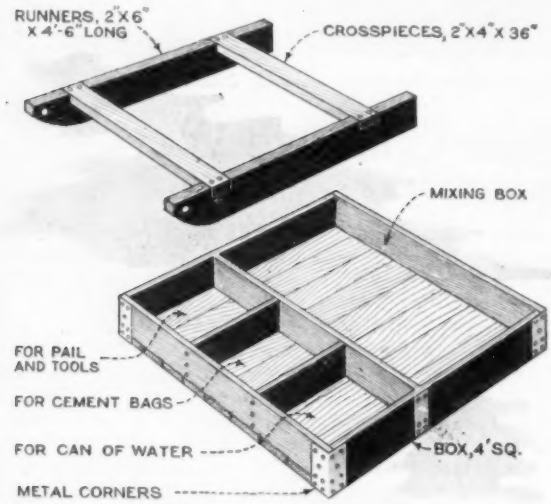
By J. R. KOONTZ

MANY small concrete jobs on the farm are put off or left undone entirely for lack of a box in which to mix the concrete. Often there is a corner post to be cemented in, or other little jobs to be done that require only a few pails of the mix; to hunt up a suitable box every time takes up more time than the job itself, with the consequence that the job is often held over to another day—which never comes. If the farmer will make a special mixing box as shown in the accompanying illustrations, he will find that most of the labor is taken out of the chore of mixing concrete. The box can be made in an hour or two of spare time, and will last for years, so that it will prove a paying investment, aside from the decided convenience of the device when in use. Get two pieces of lumber, 2 in. thick, 4½ ft. long and 6 or 8 in. wide, preferably oak or other good hardwood, and round off one end of each to the shape of a sled runner, then cut notches in each upper edge and bolt 2 by 4-in. cross members, 36 in. long, to them. Spikes can be used to fasten the crosspieces instead of bolts, if desired; if bolts are used, both the heads and the nuts must be sunk into the wood to clear the ground on the one side and the box on the other. On top of the sled build a platform from good boards, 4



Here Is a Mixing Box That Will Save the Busy Farmer a Lot of Time Otherwise Spent in Getting Ready for Small Concrete Jobs

ft. square, and, with 8-in. boards, make this into a box divided into four compartments as shown in the drawing, then bind the corners and the junction of the main partition with the side boards with galvanized sheet iron. If there is enough sheet metal on hand to cover the bottom of the box, it should be applied as an additional precaution against leaking; if not, the joints in the bottom must be made as tight as possible. The mixing compartment should be about 3 ft. wide. Bore two holes in the front ends of the runners and pass through the holes a length of chain or cable to serve as a hitch, and the box is completed.



Details of the Mixing, Tool and Material Box for Concrete; Above, Construction of the Sled Frame

Now, a few pails of sand can be placed in the proper compartment, a bag of cement, a can of water and all the necessary tools each in their own place, and then the team hitched onto the sled to drag it to the place where the work is to be done. After the job is finished, the outfit can be put under shelter with the tools and supplies left in place ready for the next small job. If no shelter is available, the materials should be removed and stored in a dry place, and in this case the sled should be given one or two coats of creosote to preserve it from the weather.

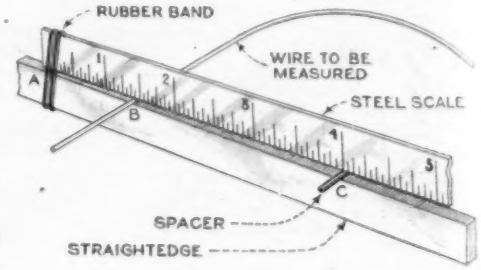
If desired, the frame can be fitted with wheels instead of making it into a sled. The wheels, if used, should not be over 12 in. in diameter, so as to keep the box at a convenient height for mixing and placing the concrete.

Quenching Heated Tools

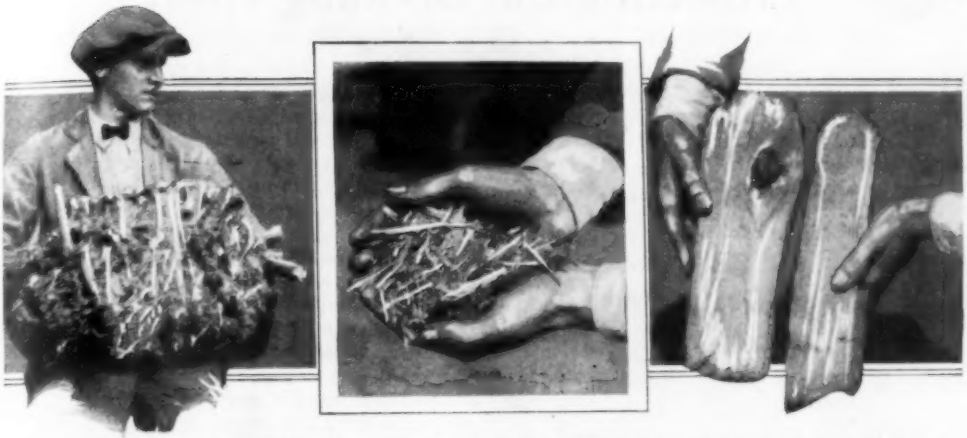
When taking hold of a tool that has been heated all over, it is important that the tongs are not cold or damp. They should be brought to a dark-red heat. It is also advisable to use tongs that have sharp grips, so that there will be as little contact between the tongs and the tool to be cooled as possible. If these precautions are not followed, cracks may result in the tool due to uneven cooling.

Emergency Method of Finding Wire Diameter

When a wire gauge or micrometer is not at hand, the improvised V-gauge shown in the illustration will serve to measure the size of any wire. A steel scale is held against a straightedge securely by means of a rubber band. A short length of wire of known size is used for a spacer and is placed between the scale and the straightedge at an even inch point of the scale, say, at C. The wire to be measured, if smaller than that used as a spacer, is pushed down in the V-shaped slot thus formed, until it fits snugly in it without lifting the tied end of the scale. The distance of this point, B, from the end A of the scale is noted, and the size of the wire is found by multiplying the diameter of the spacer by the distance AB and dividing the product by the distance AC. If the wire to be measured is larger than the spacer, it is slid between the scale and straightedge to the right of the spacer as before, but the rule for calculating its size remains the same. Or a spacer larger than the wire of unknown size may be substituted if at hand.—E. S. Therkelsen, Moore, Pa.



Emergency Method of Finding Size of Wire with Steel Scale and Straightedge



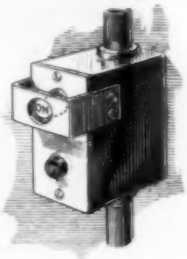
Burning Pressed Bark from Which About Fifty Per Cent of the Moisture Is Eliminated, Reduces Fuel Cost of Paper Mill About $75 Daily

Pressed Bark for Fuel

Pressing about fifty per cent of the moisture out of bark changes it from an uncombustible and cumbersome waste to a good fuel. It has been used to replace some of the coal required by a large paper mill, and it is estimated that a saving of $75 per day was effected by using this waste. The photo at the left shows pressed bark mixed with wood waste as it goes to the boilers. Splinters and chunks of wood, like those shown in the other two photos, which run off with the water from the barker drums and are a source of stream pollution, are handled with ease along with the bark.—Forest Products Laboratory, Madison, Wis.

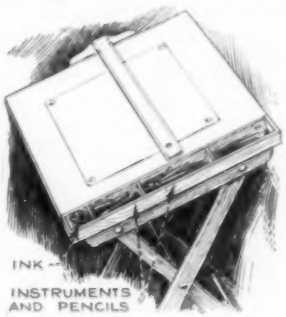
Safety Guard on Power Switch

Push-type switches of the kind shown in the illustration are often used on electrically operated machines, and if no safety guard of any kind is placed over them, they may be accidentally thrown on, at a moment when this would be dangerous. A simple guard can be made in a few moments by drilling a finger hole through a short strip of flat metal, bending it over the "on" plunger of the switch and screwing it down securely as indicated. It is then impossible to push the plunger in unless the finger is inserted through the hole in the guard. Of course, a similar guard is unnecessary on the "off" plunger as no danger is usually connected with the machine stopping unexpectedly.



Convenient Draftsman's Tray

There are sliding trays, disappearing ink wells, etc., all to facilitate the draftsman's work, but these aids are often more or less complicated, get out of order quickly and are therefore soon discarded. A handy tray, which has proved convenient in actual practice, is not in the way, and is simple to make, is shown in the illustration. A small wooden trough, divided into three or four compartments to hold pencils, erasers, instruments and ink well, is nailed to one edge of the drawing board or to the edge of the table. In order not to interfere with the use of the T-square, it should be so attached that it does not project above the surface of the board. By keeping the instruments in compartments, the draftsman knows exactly where to find one quickly when he needs it.



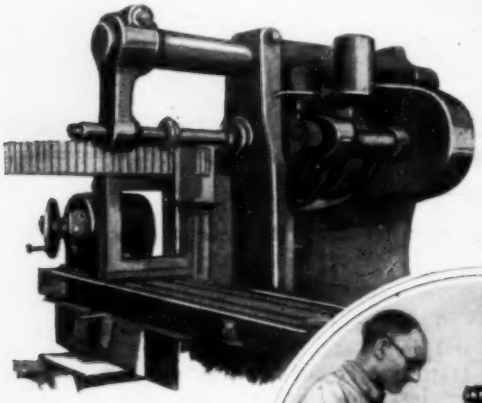
Painting Old Window Shades

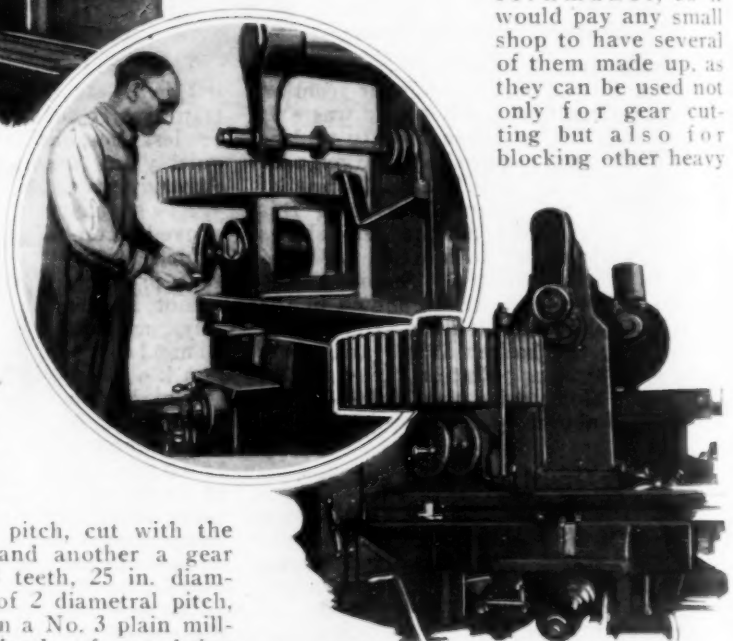
Take stiff white lead, containing little oil, and mix to a stiff paste with turpentine; add color as desired. Stretch the shade on a frame and apply the paint with a broad bristle brush. It should be used thin, and a second coat may be necessary. The less paint required the better the work will be. Lay the paint off in a crisscross manner, not straight.

Protecting the Dividing Head

By A. W. BULMER

THE device shown in the accompanying illustrations has solved a big problem for the Southern California Edison company in their machine shop, and jobbing shops all over the country should appreciate the utility and simplicity of the attachment also, as many of them have encountered the same difficulty—that of holding large gear blanks securely while milling the teeth, and protecting the dividing head from undue strain. One of the photos shows a 78-tooth gear of 3 diametral pitch, cut with the device in position, and another a gear weighing 650 lb., 48 teeth, 25 in. diameter and 8-in. face, of 2 diametral pitch, accurately finished on a No. 3 plain milling machine, the depth of cut being 1.079 in.





Above, Cutting a 78-Tooth Gear with Rest in Position; Center, Indexing the Gear; Below, Cutting Teeth on 650-Pound Gear

The device is merely a rectangular casting, the sides and top being 2 by 2 in. square, and the bottom 2 by 2½ in. in size; the top and bottom are planed, and the rest is adjusted to height, which, of course, varies for different gears, with ordinary key-steel blocks, the fine adjustment being made with shim steel, .005 in. thick. The rest is clamped to the table with two ⅝-in. bolts, as shown in one of the photos.

The principle of clamping the work directly to the table is sound, as it relieves the dividing head of the thrust and strain of the cut and the side strains of a slightly wobbly cutter. It also permits faster feeds and heavier cuts, which more than offsets the time lost in releasing the clamp while indexing the gear. By the use of the rest, an accurate product is also assured.

The work shown in the lower photo is a wonderful performance for a small machine, and was made possible only by this device. It would not be advisable, under any circumstances, to mount gears of this weight on the dividing head without some additional support, yet, in the jobbing shop, the miller is the only machine usually available for cutting the gears. The pattern for this device is very simple and does not demand the services of a patternmaker, so it would pay any small shop to have several of them made up, as they can be used not only for gear cutting but also for blocking other heavy work on the milling-machine platen; their general utility will offset their slight cost, and, in many cases, they will save the time of the operator that might be spent in hunting for suitable blocking for heavy castings.

¶ It is usual practice to add japan to paint to hasten its drying but this rather retards than hastens the process and makes the paint dry soft. It is better to add about one-fourth as much water glass as the quantity of paint.

Hardening Carbon-Steel Tools

A small pocket compass is a valuable aid to the carbon-tool hardener. It should be placed on a wooden box or a stool in such a position that the heated tool can readily be swung over it from time to time, while it is being heated. When cool, the tool will cause the compass needle to deflect, but when the tool has been heated it has less effect. As soon as no deflection of the needle is noticed, it is time to quench the tool. It must be remembered, however, that the tongs used to hold the tool will also cause the needle to deflect, so a brass hook should be used to hold it above the compass. The temperature at which the tool should be quenched is called the "decalescence point" and this is the point where the magnetic effect of the steel disappears.

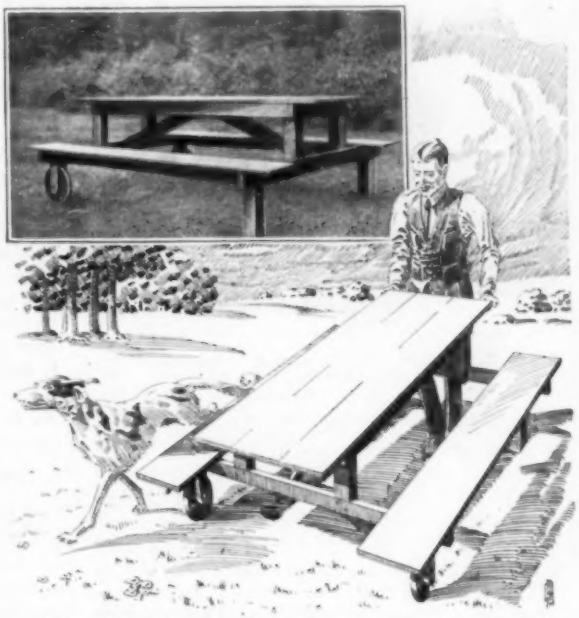
Pulverizing Stone Fences

Farmers in southeastern Kansas are pulverizing their stone fences to get limestone dust with which to "sweeten" their soils. Legumes, such as alfalfa, clover, cowpeas, etc., will not grow in acid soils and the application of limestone corrects this condition. The pulverizing equipment is owned by individual farmers, groups of farmers and farm organizations, and consists simply of an ordinary portable rock-crushing machine. The cost of pulverizing is about 85 cents per ton, and the material lies in abundance in fields and pastures. The photograph shows a stone fence being pulverized with this machine. —J. M. Collins, Kansas City, Mo.

Pulverizing Stone Fences to Obtain Lime for Sweetening Soil

Portable Picnic Table

In parks and picnic grounds where tables and benches are usually provided, it is rather inconvenient to move them from place to place. The combined table and benches shown in the illustration, therefore, is an improvement, as it can be moved wherever necessary. Two of the legs are provided with wooden wheels, about 10 in. in diameter, fitted with metal tires and hubs, cut from pipe. Bolts, fitting inside of the hubs, serve as axles. The construction is clearly shown. One end of the table is lifted and the outfit can then readily be pushed along like a wheelbarrow.—C. L. Meller, Fargo, N. Dak.



Portable Picnic Table Can Be Wheeled Wherever Needed

Preventing Solder from Spreading

Whiting, mixed in water, may be used to prevent solder from spreading in fine jobs, where the surface must be kept free from solder except at the point where it is needed. A fine brush is used to paint the whiting over the metal outside of the soldered area. When applying flux, care must be taken not to permit the whiting to absorb too much. The solder is then applied in the usual manner.—Sherwood J. Gee, Montpelier, Idaho.

Borders for Halftones

Newspapers and other publications using halftone cuts for illustrative purposes often desire some kind of fancy

Bristol-Board Masks for Newspaper Halftones Eliminate Considerable Art Work

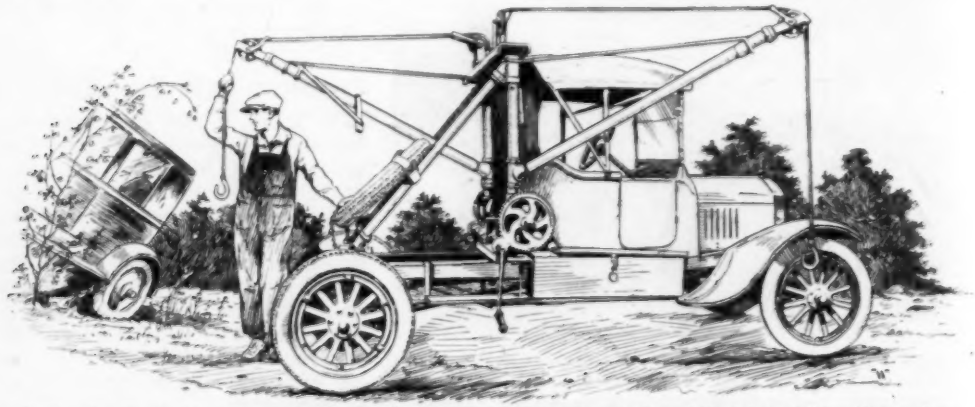
border for the photos. Rush work, or the lack of an adequate art department, often makes it impossible to form a border by the usual blocking-out process. The following system was devised to overcome this difficulty, and provided a quick and easy way of providing borders. A number of border designs are drawn by an artist upon white, smooth Bristol board, not too thick. The space where the photo is to appear is cut out carefully with a razor blade, the remainder forming a mask. In use, this is placed over the photo in the desired position. The resulting halftone will be no different from those produced in the usual way. It often happens that the mask is not of a size to fit the picture. This does not render the process useless, however; for the mask can be enlarged or reduced to the desired size and then the photo can be combined with it in the desired proportions. It has been found advisable to have available a supply of masks of varying sizes and designs to prevent monotony arising from too frequent use of the same mask. The system described has been used for some time by two large Ohio newspapers.—W. E. Burton, Kenmore, Ohio.

Flat Oil-Water Paint

Place 50 lb. of gilders' whiting in a washtub and cover it with water; let it stand overnight to permit the water to percolate through the mass. If any water remains on top in the morning, pour it off. Beat up the mass with 2 gal. of hard oil or gloss oil, or any cheap varnish, and stir in any desired coloring. Thin down with benzine; but if the higher cost of turpentine is not objectionable, this is a better thinner. This paint dries flat and without luster.—A. A. Kelly, Malvern, Pa.

Swinging Booms on Service Car

By mounting two swinging booms, made of heavy pipe and fittings, on the chassis of a light automobile made over into a service car, an Alabama dealer increased its usefulness considerably. The two booms are fastened together at the rear with two cross members of iron. Recently the car was sent out for a one-ton truck loaded with lumber, which had gone over a 20-ft. embankment. The truck was pulled up without unloading it. This was done by swinging the two booms at right angles to the car, anchoring one to a tree on the side of the road opposite the wreck, while the other boom was used in pulling up the truck.—Archie Richardson, Decatur, Georgia.



Service Car Equipped with Two Swinging Booms Made of Heavy Pipe Is Found Useful for Lifting Heavy Cars up Embankments as Well as for Towing Purposes

How To Use Twist Drills

Part II

WHEN we refer to the "speed" of a drill, we mean the speed at the circumference, called the peripheral speed. Speed, in this case, refers to the distance the drill would travel, if, for instance, it were laid on its side and rolled. Thus, a drill with a peripheral speed of 30 ft. per minute would roll 30 ft. in one minute. Speed, as generally used, does not refer to rotation per minute or revolutions per minute, unless this is specifically stated.

Except under certain rather rare conditions, a drill does not pull itself into the work like a corkscrew—it requires constant pressure behind it to advance it. This advance (measured in fractions of an inch per revolution) is called "feed." Feed pressure, however, is the pressure required to maintain the feed. The feed is produced either by hand or power to force the drill into the work.

Opinions differ regarding the correct speed and feed, therefore we must come to the conclusion that no hard-and-fast rule can be given. The following suggestions should be considered merely as guides. Under any given condition, the correct speed and feed can only be determined by the application of good sound judgment in each particular case.

Starting Speeds and Feeds

In starting a drill, bring it down to the work by hand feed until it centers itself in the work. Then throw in the power feed. It is a safe rule to start drills made of carbon steel with a peripheral speed of 30 ft. per minute, if they are working in soft tool or machinery steel; this should be increased to 35 ft. per minute for cast iron and 60 ft. per minute for brass. The starting feed should vary from .004 to .007 in. per rotation for drills ½ in. in diameter and smaller; for drills larger than ½ in., .005 to .015 in. per rotation. At these speeds and feeds, it is recommended that a good cutting compound be used.

In the case of high-speed drills, the above feeds should remain unchanged; the speeds, however, should be increased from 2 to 2½ times. We suggest that the drill be started with a moderate speed and feed, increasing either one or both after observing the condition of the drill. That the observations may be intelligent and the adjustment of speed and feed based on the requirements, carefully observe the behavior of the drill, as we will now proceed to tell.

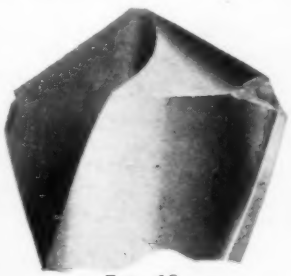


FIG. 20
Drill Run at Too Great Speed

Indications of Too Much Feed

If the drill chips out at the cutting edge, it is a sure indication of too heavy a feed or too much lip clearance. If a drill splits up the web, it is also evidence of too much feed for the amount of lip clearance. Decrease the feed or increase the lip clearance, or do both. Failure to give sufficient lip clearance at the center of the drill will cause it to split up the web. On the other hand, too much lip clearance at the center (or any other point on the lip) causes the cutting lips to chip. Therefore, before blaming the feed, it would be well to make sure that the drill is properly ground. If it is, decrease the feed.

Courtesy Cleveland Twist Drill Co. ©

Indication of Too Much Speed

When the extreme outer corners of the cutting edges wear away too rapidly (Fig. 20), it is an evidence of too much speed. High speeds in cast iron tend to wear away the margin of the drill; 35 ft. per minute is the maximum we would suggest for carbon drills in cast iron. The feed may be from .007 to .015 in. per rotation according to the hardness of the metal being drilled. In general, a high speed with a light feed is recommended. It is better to err on the side of too much speed than on the side of too much feed, except for cast iron where the nature of the metal may permit an unusually heavy feed. The speed can be increased to the point where the outside corners commence to show signs of wearing away. When such signs are noted, the speed can be slightly reduced and then maintained at this point.

FIG. 21

Special Grinding for Very Hard Material; the Rake Angle Is Reduced

Drilling Hard Material

Very often, even after the drill has been ground properly and the speed has been increased to the extreme limit, the drill still fails to penetrate. This is usually caused by a hard spot in the material itself, and can be remedied, or at least materially helped, by liberal application of turpentine directly to the work. The drill may be assisted in almost any hard material by the use of turpentine or kerosene. Another method is to reduce the entering angle of the lips (the rake angle) as in Fig. 21, so as to permit the use of heavy feed pressure. If heavy feed pressure were used without first grinding the sharp angles off the lip (called "raking"), the drill would chip severely on the lips. This removal of the sharp angle of the lips, however, must be done with extreme care and judgment, or the drill will have to be reground throughout.

Variations in the hardness of the material drilled can only be met by the skill of the operator and his adjustments of the combination of speeds and feeds. The commercial twist drill is tempered for average conditions—to give good results in a wide variety of hard and soft material. Sometimes specially tempered drills are used on exceptionally hard material, but such drills must be made to order. Their use can be avoided by a skilled manipulation of the speed, feed and lubricant. The harder the metal, the lighter the feed and the slower the speed, forms a rough-and-ready sort of rule that is generally applicable.

Small-Hole Drilling

In drilling holes of small diameter, unless the feed and speed are given most careful attention, the danger of breakage is very great, especially at the moment when the point of the drill breaks through the other side of the work. Particularly is this moment dangerous when hand feed is used, because it is difficult to regulate the pressure applied to the feed lever with any degree of exactness.

In some shops, specializing in the manufacture of wool combs and similar products, thousands of holes of various sizes, running as small as .013 in. in diameter are drilled daily through brass plates 7/16 in. thick. This work is accomplished

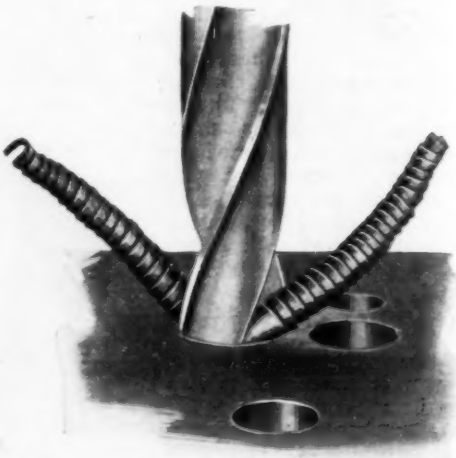


FIG. 22

Properly Rolled Chips; Note How Compactly They Fit within Themselves

without difficulty by carefully grinding the drills, honing them on a whetstone, and running them at 20,000 r.p.m. This speed is increased to 30,000 r.p.m., when the holes are .013 in. in diameter. Outside of this particular industry, it is rare to come across a small drilling machine running at more than one-fourth of its proper speed. Therefore, let us urge, when drilling with small drills, rather lean toward too much speed than not enough, and keep the feed light. This decreases the tendency to break the drill and also increases output.

Drilling Brass

Owing to the nature of brass, a heavier feed than for the harder materials may be used, especially in automatic machines, in order to insure the chips having sufficient body to follow the flutes out of the hole. For brass, if any lubricant is used, paraffin oil is suggested. A special drill is made for brass work; when ordering this specify for brass. The form of point shown in Fig. 24 will also be found efficient in drilling soft material such as brass, where the normal point tends to "hog in" or "grab." This applies also to copper, in which the point acts similarly.

Cutting Compound

To maintain the speeds and feeds recommended, it will be found necessary to use some good cutting compound, and we recommend the following, in the order named: for hard and refractory steel, turpentine, kerosene, soda water; for soft steel and wrought iron, lard oil, soda water; for malleable iron, soda water; for brass, a flood of paraffin oil, if any lubricant is used; for aluminum and soft alloys, kerosene, soda water; cast iron should be worked dry or with a jet of compressed air as the cooling medium.

For automatic machines, where the holes do not exceed two drill diameters in depth, and under a flood of lubricant, high speeds and light feeds are especially recommended. When holes are deeper than two drill diameters, it is sometimes difficult to get rid of the chips. A point like that shown in Fig. 21 is especially efficient under these conditions, with slower speed and heavier feed as the bottom of the hole is approached. Always endeavor, in automatic drilling, to get a small, compactly rolled chip (Fig. 22), and if possible keep it unbroken the entire depth of the hole, as such a chip feeds through the flutes most easily. When a drill seems to be drilling fairly well, yet the surface of the hole is rough (Fig. 23), it is an indication that the drill

FIG. 23

This Rough Hole Was Made with a Dull Drill

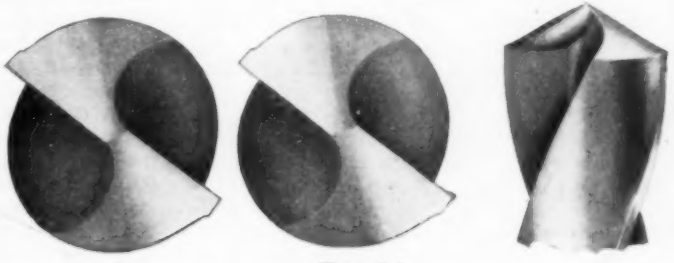


FIG. 24

Drills at the Right and Left Have Been Thinned; the One in the Center Has Not. Below, Convenient Method of Always Having the Proper Drift Handy That Saves Both Time and Drill Tangs

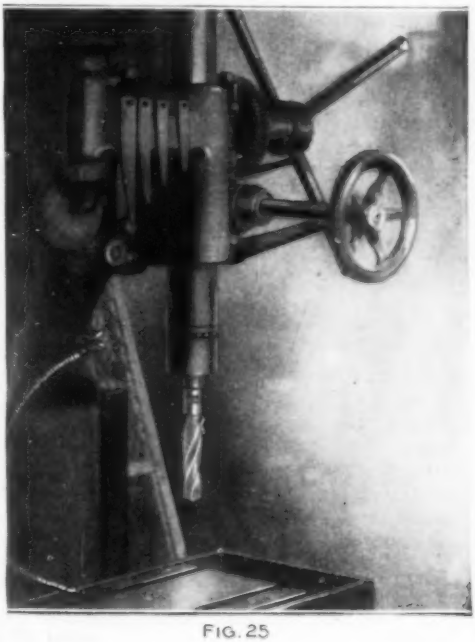


FIG. 25

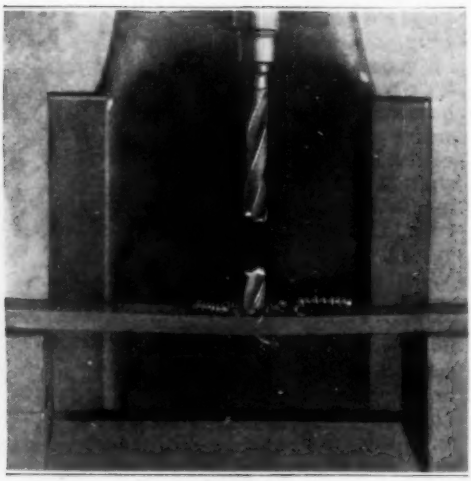


FIG. 26
The Result of Spring in the Work—a Broken Drill

is dull and, therefore, should be resharpened without delay.

Thinning the Point

Drills may be made to feed more easily into the work by a process known as thinning the point. This is an extremely delicate operation, and should not be undertaken except by a skillful operator. It is, however, a decided assistance where the hand feed is used, or where one is using high-speed drills with unusually heavy webs. To thin a point properly, a round-faced emery wheel is necessary, and the drill should look like Fig. 24 when finished. Be very careful, in thinning the point, to keep the dead center of the drill in the exact center, and, also, not to weaken the web too much by running the ground-out section too far up into the flutes.

Common Errors

Broken tangs result from a variety of causes. They may be traced to the use of badly mutilated sockets; of drills the shanks of which are so badly "banged up" that they do not fit snugly in the socket, or of drills with badly mutilated tangs. Although the tang of a drill is designed to carry a portion of the driving strain, the tapered fit between the shank of the drill and the walls of the socket should carry a large share of it. As a result, if either the inner wall of the socket or the surface of the shank is mutilated, a perfect fit is impossible. Under such conditions, the whole driving strain is thrown on the tang. Often the tang breaks from wrong treatment of drill or socket.

Before inserting a drill in a socket, rub the shank to make sure it is smooth and free from grit. Also inspect the inside of the socket to be sure it is in the same condition. In drifting a drill out of the socket, never use anything but a drift (Fig. 25). The use of such makeshifts as files or wedges is likely permanently to injure either the drill or the socket, or both, with broken tangs resulting therefrom. In removing the drill from the spindle or socket, take great care that the point of the drill, or tip, does not hit the table of the drill press or the work. It is well to have a block of wood handy, onto which the drill can drop as it is drifted out.

When inserting a drill into a socket, never use a machinists' hammer, as this dulls the tip of the drill and nicks the cutting edges. Always use a material softer than the drill itself, such as a lead hammer, or a piece of heavy wood.

One of the most common causes of drill breakage is lack of rigidity in the drill press or work. Drill presses that are too weak to resist the feed pressure without springing, either through faulty design of the table or of the feeding parts, and drill presses having lost motion in the spindle, invite drill breakage, because of the sudden release of the resistance to the feed pressure when the drill breaks through the far side of the work. This causes the lips to catch, and the resulting strain is sufficient to break the drill. The same results come about

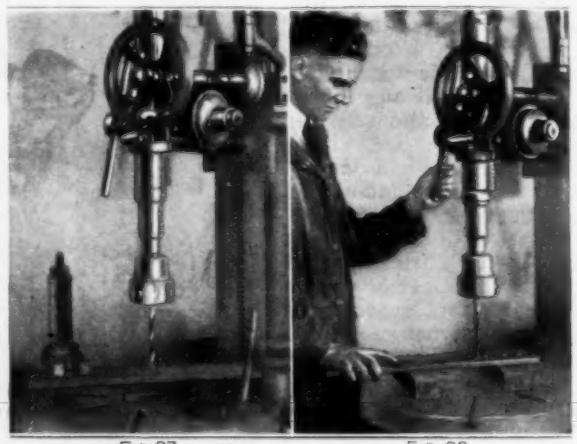


FIG. 27 FIG. 28
Work Should Always Be Clamped to the Table as at the Left, Never Held as at the Right

from faulty setting up of the work. Underneath the drill the work should be absolutely rigid and free from spring, otherwise breakage is almost sure. The work should never be held in the hand. It should be rigidly clamped to the table of the press (Fig. *27*). If work is held in the hand, the risk of breakage, owing to lack of rigidity and side support, is enormously increased, and the danger to the operator from whirling work is considerable.

It is good practice to warm the cutting lubricant before using it with high-speed tools. Any hard piece of steel is extremely brittle when cold, and high-speed drills should never be put to work in that condition. They operate much better when warm, often giving good results when the chips are actually turned blue by the heat generated. Nothing will "check" (fill full of small cracks) a high-speed drill quicker than to turn a stream of cold water onto it after it has become heated while working. It is equally bad to plunge it into cold water after the point has been heated in grinding. Either of these practices is certain to impair the drill.

A fact often lost sight of, even by experienced users of drills, is that cutting ability and hardness are not the same thing. This is especially true of high-speed drills. The apparent hardness of a drill varies with the composition of the steel, and is no indication of the cutting ability. Some of the best high-speed tools we have ever tested could be filed so readily that, were filing an indication of the work to be expected from them, they would be condemned without a working trial.

A high-speed drill so hard that it cannot be filed may, by exercising extreme care, be made to drill extremely hard material. But such a drill will be found so brittle as to be worthless for softer materials, or where a large amount of work must be done in a given time. Numerous tests have proved that the hardness of files varies quite as much as that of other hardened tools, and this is an-

Feet per Min.	30′	40′	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′
Diameter In	Revolutions per Minute												
1/16	1833	2445	3066	3667	4278	4889	5500	6111	-----	-----	-----	-----	----
1/8	917	1222	1528	1833	2139	2445	2750	3056	3361	3667	3973	4278	4584
3/16	611	815	1019	1222	1426	1630	1833	2037	2241	2445	2648	2852	3056
1/4	458	611	764	917	1070	1222	1375	1528	1681	1833	1986	2139	2292
5/16	367	489	611	733	856	978	1100	1222	1346	1467	1589	1711	1833
3/8	306	407	509	611	713	815	917	1019	1120	1222	1324	1426	1528
7/16	262	349	437	524	611	698	786	873	960	1048	1135	1222	1310
1/2	229	306	382	458	535	611	688	764	840	917	993	1070	1146
9/16	183	244	306	367	428	489	550	611	672	733	794	856	917
5/8	153	203	255	306	357	407	458	509	560	611	662	713	764
11/16	131	175	218	262	306	349	393	436	480	524	568	611	655
1	115	153	191	229	267	306	344	382	420	458	497	535	573
1 1/16	102	136	170	204	238	272	306	340	373	407	441	475	509
1 1/4	92	122	153	183	214	244	275	306	336	367	397	428	458
1 3/16	83	111	139	167	194	222	250	278	306	333	361	389	417
1 1/2	76	102	127	153	178	204	229	255	280	306	331	357	382
1 5/16	70	94	117	141	165	188	212	235	259	282	306	329	353
1 3/4	65	87	109	131	153	175	196	218	240	262	284	306	327
1 7/8	61	81	102	122	143	163	183	204	224	244	265	285	306
2	57	76	95	115	134	153	172	191	210	229	248	267	287
2 1/4	51	68	85	102	119	136	153	170	187	204	221	238	255
2 1/2	46	61	76	92	107	122	137	153	168	183	199	214	229
2 3/4	42	56	69	83	97	111	125	139	153	167	181	194	208
3	38	51	64	76	89	102	115	127	140	153	166	178	191

Above, Model Drill Point That Will Aid in Grinding Drills; Center, Handy Pocket Chart of Feeds and Speeds; Below, Table of Cutting Speeds

other reason why file tests are unreliable. No drill that "files" hard or soft should be condemned for that reason alone, but should first be given a drilling test in material of known hardness.

Key to Table

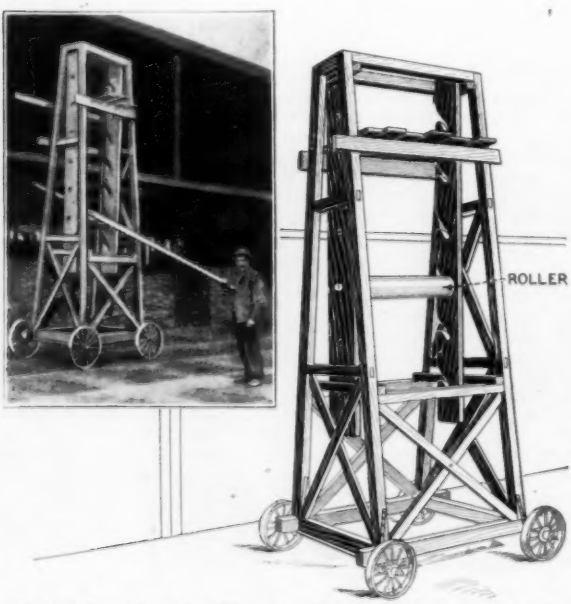
The table of cutting speeds given herewith should be used only as a guide, and the correct speeds for drills should be determined by good judgment applied to each individual case. It is safe to start carbon drills with a peripheral speed of 30 ft. per minute for soft and machinery steel, 35 ft. per minute for cast iron, and 60 ft. per minute for brass, using in all cases a feed of from .004 to .007 in. per rotation for drills smaller than ½ in. and from .005 to .015 in. per rotation for drills larger than ½ in. in diameter. At these speeds, a suitable cutting compound should be used for wrought iron and steel. In the case of high-speed steel, the above feeds should remain unchanged, but the speeds should be increased from 2 to 2½ times. All the speeds recommended are only speeds at which the drilling should be started. They are approximate, and for average conditions only. They can be greatly exceeded under some conditions, but under others they will have to be reduced. In all cases, the operator should be guided by observing the condition of the drill in connection with the suggestions previously given.

The model drill point, shown above the table, will be found especially valuable in learning to grind drills correctly, so as to do more and better work and keep the number of broken drills down to the minimum. The line across the center of the drill point between the cutting edges should be as in the model point. This is of the utmost importance, as an experience of over forty years has proved that 99 out of every 100 drills that split up the center are improperly ground at this point. This model drill point can be obtained from one of the large drill companies for 55 cents.

Below this is another valuable aid for the driller. It is a celluloid disk giving decimal equivalents of fractions, tap and drill sizes and proper speeds and feeds for both high-speed and carbon drills. This costs 25 cents.

Handy Truck for Lumber Yard

A Nebraska lumber company employs a novel, movable derrick to save time in unloading lumber from the cars to the sheds. A spur track from the railroad yards extends along the front of its sheds. A concrete walk provided in the space between the track and the shed, makes a smooth surface over which the truck can be moved. The truck consists of a tapered frame, about 18 ft. high, and is mounted on four iron wheels. The frame carries two planks, one of which has 2-in. holes bored through it every 16 in. and the other similarly bored and notched out as shown, to support a movable roller with a pipe axle at various heights. When a car of lumber is to be unloaded, the truck is moved along until it is in front of the car door. The roller is then adjusted to the desired height; if the lumber is to be stored on the first deck, the roller is set to work best for that height and if the lumber goes overhead the roller is set higher. One man in the car pushes the timbers over the roller into the shed and another man in the shed takes the piece and stacks it. Large timbers weighing between 100 and 200 lb. have been handled without any difficulty in this manner.—Dale R. Van Horn, Walton, Nebr.

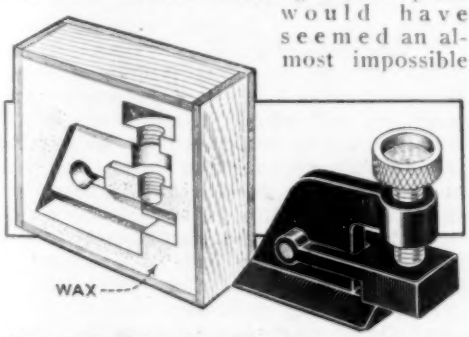


Wheeled Derrick with Adjustable Roller Facilitates Transferring Lumber from Railroad Cars to Sheds

Making "Drawings" in Wax

There is a story told of a farmer who went to a machine shop to get a certain part made from a model which he had whittled out of a potato. This, while unconventional, admittedly is good practice from the farmer's standpoint and so are other interesting examples of the "every-man-to-his-craft" expedients that find their way into the shop. Not long ago a machine shop received a wax impression for a clamp used by electrotypers. The customer wanted duplicates but could not spare the old parts, as they were in constant use. The machine shop had done some of the work years before under contract, but had no drawings to refer to; however, duplication from the wax impression was almost as simple as it would have been from prints.

It will be noted that there is a body with a beveled foot that slides in a dovetail slot, a hinged piece with a leather pad at the clamping point, and a screw with a small handwheel. All these were modeled in the wax mold to exact size. The special thread was easily discernible and also the size of the taper pin, the angle of the base, and the fuzz showing the leather. Only the recess in the wheel would not draw from the mold, and this had to be filled in by the "artist." This stunt is an evidence of ingenuity and the possibility of using methods of other trades when customary methods are not available. To make a drawing of this piece would have seemed an almost impossible task to the workman in the electrotyping plant, but the molding of wax to show the minutest detail was an everyday affair for him, and therefore it was but natural to make the "drawing" in this way.—D. A. Hampson, Middleton, N. Y.

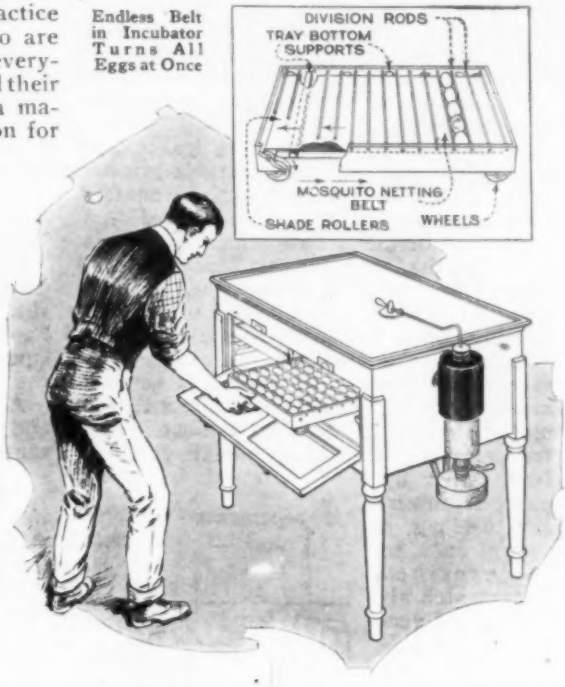


Electrotyper Makes Wax Mold Instead of Drawings of Part to Be Duplicated by Machine Shop

Turning Eggs in Incubator

Many devices have been invented to turn eggs in incubator trays automatically or with the least possible loss of time to the operator. The egg-rolling belt shown in the illustration, is a simple one, and can readily be installed in almost any standard incubator tray. All that is necessary is to cut an opening in the wire-screen bottom at each end, to accommodate rollers over which an endless belt of mosquito netting is run. The rollers are made of lengths of wooden shade rollers, cut to fit inside of the tray so that the upper part is just flush with the screen bottom. Four small wooden wheels, with strips of rubber cut from old inner tubes glued to the edge are provided under the rollers, just far enough from the edge of the tray to prevent interference with the tray supports. Lengths of No. 10 wire are arranged across the trays, if not already provided, and are strung just far enough apart to allow the eggs to rest in the spaces between them. When the tray is removed from the incubator to turn the eggs, it is only necessary to place it on the table so that it rests on all four wheels, and a slight push then serves to revolve the rollers which operate the belt causing all the eggs to be turned over at once.

Endless Belt in Incubator Turns All Eggs at Once

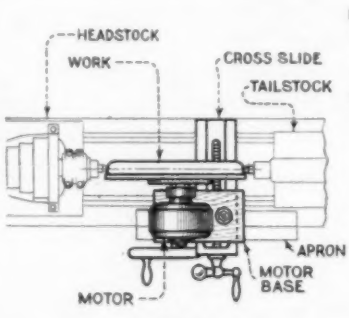


Surface Grinding in the Lathe

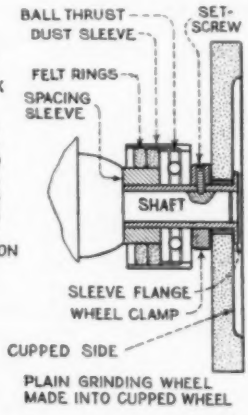
By H. H. PARKER

AN extemporized lathe surface-grinding attachment is one way in which a small shop that is not equipped with planer or shaper may often turn out fairly good work which otherwise would be very difficult, if not entirely impossible, to accomplish.

A stock motor of from ⅛ hp. up, or preferably one of the portable-grinder type, of high speed and proportionately greater power for its size, is mounted on a hardwood or metal base which in turn is bolted to the lathe toolpost block or cross slide. The work is either held clamped between centers, and blocked to prevent turning, or is bolted to special brackets attached to the lathe bed. In general, the face of the work to be ground is vertical and a cupped wheel attached direct to the motor shaft is brought up against it and traversed by the longitudinal carriage feed, either by hand or power. By using a special base, to be described later, which allows slight vertical adjustment of the grinding wheel, it would be possible, in some cases, to use a plain wheel. The motor would be blocked up until the face of the wheel was over the surface to be ground, which here would be horizontal instead of vertical, and almost touching it. Then the vertical adjustment would be set so that the wheel started to cut, clamped, and the wheel traversed over the work.



LATHE WITH MOTOR AND CUP GRINDING WHEEL MOUNTED ON CROSS SLIDE.



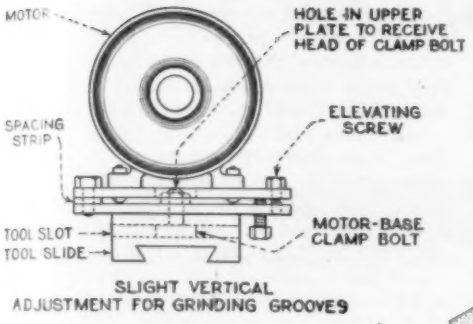
PLAIN GRINDING WHEEL MADE INTO CUPPED WHEEL

The accuracy of this kind of grinding depends upon the fitting of the cross slide; any play here would be transmitted to the wheel and work, unless very light cuts were taken. But to a much greater extent, accurate grinding requires good motor bearings, for a small high-speed wheel is sensitive to any play in the bearings. Hence it is best to use a new motor for this work, or else fit new bearings to an old one, unless the bearings are in perfect condition. While it is possible to turn out fair work with an old motor, the wheel is extremely likely to "dig in," and cut hollows in the surface.

One of the illustrations shows how a plain grinding wheel may be made into a cupped one and attached to the motor shaft. If the motor is of the stock type, the wheel should be of as large diameter as possible, as even then the speed will be rather low; nevertheless, good work can be done, though the wheel may wear more rapidly. The wheel is chucked in the lathe, rotated at low speed and the side hollowed out, leaving a narrow projecting edge around the circumference. If one of the patent abrasive-stick dressers is at hand, this can be used; otherwise an old square file can be used to hollow out the wheel.

A steel sleeve, with a thin flange at one end, is then turned up to fit over the motor shaft, its outer diameter being the size of the hole in the wheel. The end flange is thin enough so that the wheel face will overhang it and allow a considerable amount of re-dressing; the wheel is clamped to the sleeve by a nut, threaded on from the back and holding it against the front flange; blotting-paper washers must be placed between flange and nut and wheel. Next a stock ball-thrust bearing is slipped on behind the clamp nut and over the sleeve, and then a spacing collar, to bear against the motor bearing housing. As the abrasive dust would ruin the ball bearing, this is protected by a housing made of brass or steel tubing, driven over the outer bearing plate, but relieved inside to clear the remainder of the thrust assembly. Some felt packing rings between housing and spacing collar will help keep out the grit and dirt. The whole is attached to the motor shaft by a setscrew through the clamp nut and sleeve.

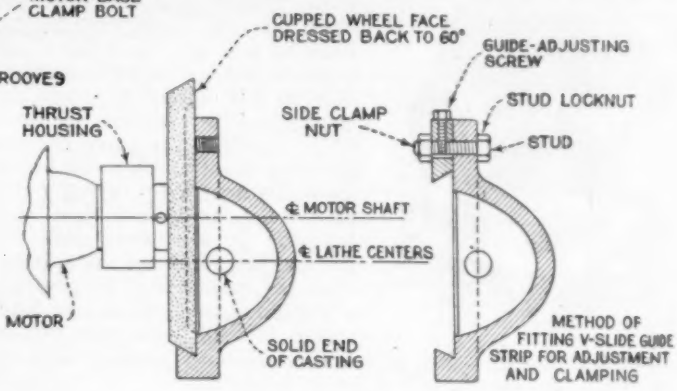
In connection with the foregoing, a method of grinding and fitting a cast-iron 60° V-slide might be of interest, as an ex-



ample of an actual job. No planer or miller being available, the casting was finished complete in the lathe by grinding, following the ideas described above. A cupped wheel was used to grind the face of the slide, the casting being held between centers with this face vertical. One V-guide had been cast with the V roughly at 60°, the other guide being bolted on later, so that its seat was ground to a plane surface. In order to grind the bottom V-groove at the same time as the face, the wheel was dressed back to a 60° angle. The motor was mounted on two steel plates, separated at one end by a steel strip and bolted together. Two adjusting bolts at the other end, one a stop bolt, served to spread the plates apart or bring them together, thus giving a certain amount of vertical adjustment to the grinding wheel. The lower plate was bolted to the cross-slide slot, a hole being drilled in the upper one to accommodate the head of the clamp nut, the square head of which fitted into the tool slot.

In grinding the casting, the wheel was first traversed across the face without cutting much in the V-groove. Then the motor was lowered slightly and a cut taken with the angular face of the wheel, into the groove, at the same time taking a further light cut across the face of the casting. Before making the finish cut, the angle of the groove should be tested and if not correct, the wheel face dressed off, a light cut taken, the groove tested again, and so on until satisfactory. The upper guide strip, which was of cast iron, but which could have been made of steel stock, was centered in the lathe and the bottom ground off, then swung around 60° and its angular face ground and tested, rotating it slightly and taking light cuts until the angle was found correct.

A rather novel method of clamping the guide, and at the same time making it serve as its own gib, is shown. The bolt holes in it were slightly elongated, while those in the casting itself were tapped and steel studs screwed in, these studs being locked in place by nuts screwed onto their rear ends. Nuts on the other ends of the studs clamped the guide strip in place. Holes were then drilled through the edge of the strip for adjusting screws, which were tapped into the studs. Thus, by loosening the clamp nuts slightly the adjusting screws could be turned and would draw the guide in; when set correctly, the clamp nuts would be tightened.



Flat-Iron Bench Supports

Casting the iron legs for their benches is the method usually adopted by large shops, but where only one or two benches are needed this would not pay. Possibly one of the best and cheapest constructions in the latter case is to make the legs of flat iron, as shown in the illustration. Any kind of ¼ or ⅜-in. strips can be used for this purpose; they are riveted together securely and the feet drilled for screws with which they are fastened to the floor. The entire end support is made up of five lengths.

Cutting Heavy Sheet Metal

A sheet-metal shear that will cut 16-gauge or heavier iron, can seldom be found in the small shop. When it is necessary to cut metal of such thickness, it can be done by using a heavy block of iron and a large file with the teeth ground off smoothly near the end, as follows: The file is placed over the edge of the block, so that it will have a shearing action, and is then driven through the metal with a heavy hammer as shown in the illustration. An additional advantage of this method is that pieces can be neatly cut out in the center. A smooth, clean-cut edge can be made in this way, which is not possible with a cold chisel.—H. E. Barber, Fowler, Colo.

Making Printers' Type and Rule

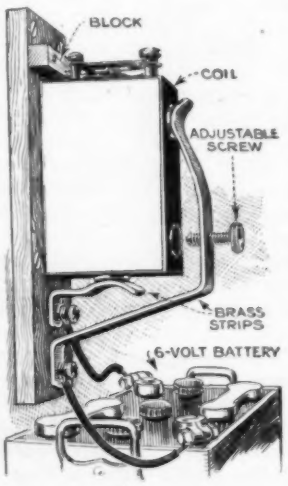
There are more effective ways of making needed wooden type in a print shop than by whittling them from the end of a pine box. One of these consists in cutting either the individual letters or words from some thin material and mounting them on a wooden base, the two together being made type high. This is far more easily done than cutting the letters from hardwood, though, of course, not so substantial. Linoleum of the "battleship" variety is one of the most satisfactory materials for this purpose as the design may be drawn directly upon it. The letters are cut out and fastened to their mounting with shellac or rubber cement. Even thick cardboard can be used in this manner, if it is given several coats of thin shellac after it has been mounted.

Those who can work in hardwood may simplify the task as follows: Get some thin paper, and after drawing the design on it, paste it onto the wood, face down, with rubber cement, which will not cause the paper to wrinkle and buckle as paste or mucilage does. Proceed to bring the letter into shape with a sharp knife. Be sure to lean the cut outward, or away from the edge being cut. A narrow chisel can be used for removing the superfluous wood between the edges, although successive stabs with a knife will do in the absence of a chisel. Several letters may be made upon the same piece of wood and then separated with a saw.

In place of drawing the letter on thin paper, the freshly printed letters from a poster may be cut out and transferred to the wood. Hold the printed letter on the wood, lay a piece of stiff paper over it and rub the back of the latter with the rounded edge of a bottle or similar smooth, hard article. If the ink on the copy is too dry, moisten the back with turpentine. Heavy rules and borders for posters can be made by laying out two rows of ordinary pica black-face linotype rule, the sort with a heavy full-face black line. Take a file and make irregular notches on top of one and bottom of the other. When the two pieces are put together a heavy double-pica rule of odd design is obtained.—H. R. Calhan, San Francisco, Calif.

Auto-Coil Tester

Testing of Ford ignition coils is almost necessary to determine whether they are in proper condition. One of the simplest methods of doing this is shown in the illustration. The testing device consists of a wooden panel with two brass strips, one of which is fitted with a small adjusting screw. The panel is about 6 by 8 in. and is fitted with a stop block on the top, while the two blades are screwed to the bottom. One blade bears against the bottom contact of the coil, while the other rests against the upper contact. The adjustable screw on the latter can be turned down against the lowest contact on the side, which is one of the high-tension terminals. A 6-volt battery can be used to supply current. The coil to be tested should show a spark of ¼ in. at the adjusting screw, if it is in good condition.



Q. **My storage battery will no longer take a full charge. What is the reason for this?** A. When a storage battery fails to take a charge, it is an indication that it needs to be overhauled at a battery station.

Q. **Will a five-tube neutrodyne receiver tune sharper on a short aerial than a long one, my aerial is now 125 ft. long?** A. You will be able to tune sharper on a short aerial than a long one. There would probably be slightly more volume on the long aerial, but you will have more difficulty in separating the stations.

Q. **Will a tube detector work better in my reflex set than the crystal?** A. A crystal makes the best detector for this type of circuit. This is due to the fact that the circuit is designed for a crystal detector for several good reasons, the most important being that the crystal acts as a stabilizer of the reflex stage. This is a critical adjustment, and the use of a tube with entirely different constants will destroy the balance which is necessary in this type of circuit.

Q. **Can I add another stage of radio-frequency amplification to my five-tube neutrodyne receiver? I would also like to use a loop with this set; would it be practical?** A. It is possible to add another step of radio-frequency amplification but it is unnecessary, and the addition of another step would mean another control knob. A loop used with this type of receiver tends to interact with the neutroformers, and its use is not advised. A loop could be used if the entire set was shielded, but this also would tend to destroy the efficiency of this type of receiving set.

Q. **I have heard that I could use my desk phone as an aerial. How can I do this? I do not expect to get distant stations, but would like to use this method for local stations, as I cannot use an outside aerial on this building.** A. This is a very simple matter; all that you need is a small tin pan or sheet of No. 26 gauge brass, 6 in. square. Place the pan or metal sheet under the desk phone and use a bulldog clip for fastening the wire from the metal sheet to the aerial post on your set. Use an ordinary ground to a water pipe. You will obtain even better results if you use a small variometer in series with the lead to the aerial post. (Fig. 1.)

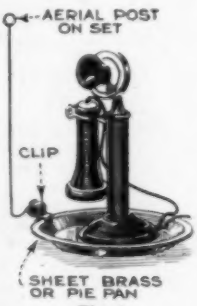


Fig. 1

Q. **I have a one-tube regenerative set that howls and whistles constantly; how can I remedy this?** A. If your set is hooked up correctly, your trouble lies in either a defective tube, or B-battery. You may be using too long an aerial.

Q. **I am getting excellent results with my receiver on the first step of A.-F. amplification, but when I use the second step, the volume is great but the signals fuzzy, especially on the higher notes. How can I remedy this?** A. This is often the case, especially if more than two steps of A.-F. amplification are used. To clarify the signals try placing a .00025 fixed condenser across the secondary of the last transformer, also try a .0005-mfd. condenser. Another method is to place a grid leak across the primary of this transformer. (Fig. 2.)

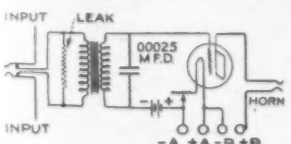


Fig. 2

Q. **I have built the Superheterodyne Eight, and am getting good results but would like to experiment with an outside aerial. How can I use an outside aerial with this set?** A. You can use a small indoor aerial or an outside aerial with this receiver if you wind two turns of loop wire around the outside of your loop, connect one end to the aerial and the other end to the ground; this gives you an untuned aperiodic aerial which will function well with this type of receiver. The method of winding is shown in Fig. 3.

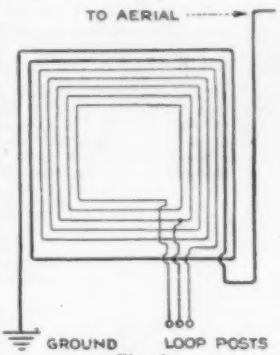


Fig. 3

Q. **I have noticed a peculiar effect with my loop. I am using a 13-turn loop on a Superheterodyne Eight receiver. There are some places in the room where this loop can be placed where it will lose its directional effect; what is the cause of this?** A. For best results place the loop where it is free to rotate, and comes not nearer than six or eight feet to metal objects of any size, such as steam radiators, bed springs, metal roofs, or lead-in wires. In such cases these articles also pick up some of the energy, which would otherwise pass to the loop, and cause the loop to lose its directional properties.

Q. **Why is larger wire used in primary coils than in secondary coils; why not use the same size?** A. Heavy wire for primary coils is necessary because the currents flowing in the primary circuit are much more feeble than those flowing in the secondary circuit, and the large wire is necessary to conserve the weak impulses.

Q. **Which makes the best connection, two wires merely touching each other and soldered, or should one wire be bent around the other before soldering?** A. Solder is for the purpose of holding the joint together, and is not for the purpose of making a good electrical contact. A good electrical contact should be made first, with a pair of wire-bending pliers, then use just enough solder to preserve the good contact already made.

Q. **I have a two-tube receiver consisting of a detector and one step of audio-frequency amplification. Would you advise me to add one stage of radio frequency, or another step of audio frequency. Which will give me the greater volume?** A. Adding one stage of radio frequency to the receiver is a waste of time and material; you would get no increase in volume. Add another stage of A.-F. amplification, if you wish more volume.

Q. **I have a five-tube neutrodyne receiver; it works very well on local stations, but I often get a crackling sound on long distance. Is this due to the batteries or a defective part?** A. The trouble is not with the batteries, or you would hear the noise at all times. When

tuning for long-distance stations you are amplifying static which is not noticeable on the local stations.

Q. Is it necessary to use a C-battery with my three-tube receiver? I am using a regenerative circuit, with two steps of A.-F. amplification. A. It is necessary

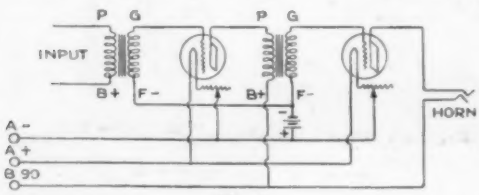
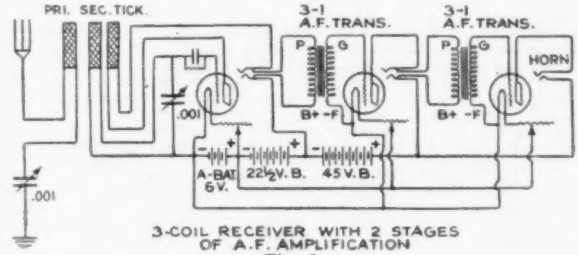


Fig. 4

to use a C-battery on most sets to obtain perfect results. Some circuits work satisfactorily without the C-battery, but reception is always improved when it is added. The diagram, Fig. 4, for connecting the C-battery is given.

Q. I have 2 All-American R12 A.-F. transformers and note that the grid and plate posts are reversed from position shown in the circuit diagram of the Superheterodyne Eight described in the Feb. and March issues of this year. Is this an error or has the transformer been changed? A. The manufacturer changed the terminal plate about the time this circuit was published. Mount the transformers so as to allow for shortest possible grid and plate leads.

Q. I have three honeycomb coils and enough other apparatus to build a three-tube receiver. Please send me a good diagram for a three-coil regenerative set. My coils are 25, 35 and 75 turns. A. This circuit is shown in Fig. 5. We suggest that you experiment with coils varying in number of turns in different positions, also with aerials of varying length for best results. The aerial should be at least 100 ft. long. Try two 50-turn coils as primary and secondary, and a 75-turn coil for the tickler.



3-COIL RECEIVER WITH 2 STAGES OF A.F. AMPLIFICATION

Fig. 5

Q. Please give me the correct grid-leak values for tubes, UV-201A, DeForest DV-6, WD-11 and 12, UV-199 and 200. A. The approximate values are as follows: UV-201A or C301A, 2 to 3 meg.; DeForest DV-6, 3 meg.; WD-11 or 12, 3 to 5 meg.; UV-199 or C-299, 3 to 5 meg., and UV-200 or C-300, 1 to 2 meg.

Q. I have a three-coil receiver, using three honeycomb coils. I have tried coils of different number of turns but cannot tune to the lower wave lengths. I am using one 23-plate condenser and one 43-plate condenser. What can I do to make the receiver tune to the lower waves? A. To lower the wave length of your three honeycomb coil set, use a 43-plate variable condenser in series with aerial.

Q. I am using a B-battery eliminator with my five-tube neutrodyne receiver; it is operated from the 110-volt a.c. lighting circuit. The directions state that if a drumming sound is heard, reverse the plug in the light socket to change the polarity. I have done this but still the set does not have good tone, and is extremely critical. The set is not at fault as I get good results when I change back to my old type B-battery. Will you please tell me what is the trouble? A. It is sometimes necessary to remove the ground wire from your set, or reception will not be clear. The lighting system forms the ground for your set.

Q. I notice in several radio articles it is mentioned that the detector tube should be in the positive lead; other diagrams show the detector in the negative lead as well as in the amplifiers. I wish to use UV-201A tubes; which connection is right? A. It makes no difference whether the detector tube is connected to the positive or negative lead of the rheostat. For the amplifier tubes, however, it is necessary that the negative lead of the rheostat should be connected to negative F of the socket.

Q. I am using a five-tube neutrodyne, and have had quite a little trouble with signals from distant stations fading. The signal will almost die away entirely then come back strong. What causes this? Is the set at fault or is it a natural phenomenon? A. Fading is seldom caused in the set. It is often due to atmospheric conditions, not local. It is also caused by detuning effect from some neighbor's set. Swinging of the aerial in the wind is another cause, especially if the aerial swings close to some metal object such as a gutter or downspout.

Q. I have a six-tube receiver consisting of three stages of radio-frequency amplification, detector, and two steps of audio. I get good results, but it seems not to be as loud on the horn as it should. With the head phones the volume is terrific. Could you suggest the cause of the poor horn volume? A. Strong signals often throw the horn out of adjustment. As soon as this critical adjustment is lost, poor results follow. Check up the speaker unit, and see that you have the correct polarity.

Q. The children turned up all the rheostats on my set and now the music comes in very faintly, although all the tubes light. What is the trouble? A. The tubes have been burned at too high a temperature with the result that their filament emission properties have been exhausted. You will probably have to get a new set of tubes.

Q. What is the best form of terminal to use on instruments, binding posts or soldering lugs? A. All wires should be attached to instruments with soldering lugs. Some manufacturers are abandoning binding posts and equipping their instruments with attached lugs only.

Q. What is the proper kind of wire for winding coils, silk or cotton-covered? A. We recommend the use of silk-covered wire in preference to the cotton-covered type.

Q. What size rheostats should be used for UV-199 tubes in groups of two and up to six; and for UV-201A tubes in the same groups? A. You can use 20 to 25-ohm rheostats for each pair of tubes, three rheostats for the six tubes of either type.

Q. I am building a crystal receiver, and wish to make my own variometer. How many turns shall I use on the stator, and how many on the rotor? A. Use 60 turns of No. 22 dcc. wire on the stator and 60 of No. 24 dcc. wire on the rotor.

Q. What material do you consider best for shielding? I am building a nine-tube receiver and wish to thoroughly shield it. A. The type of shielding material to use depends on the manner in which it is to be used. Heavy tin or aluminum foil is best for shielding the front panel; this can be put on with shellac, and is easy to cut for instrument clearance. No. 26 brass sheet makes a good shield for inter-tube and inter-transformer shielding. Copper sheet or screen makes an ideal lining for shielding the cabinet. Shielding should be grounded.

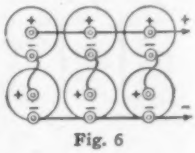


Fig. 6

Q. I have a hookup I wish to build using three UV-201A tubes; how can I use dry cell tubes with this circuit? How do I connect the dry cells and how many cells must I use with three UV-199 tubes? A. You can use the dry-cell tubes if you wish although you will not get as much volume. Use two dry cells for each tube and connect them in series-parallel as shown in diagram. (Fig. 6.)